THE GEOGRAPHICAL REVIEW

VOLUME XXII, 1932

PUBLISHED BY
THE AMERICAN GEOGRAPHICAL SOCIETY
BROADWAY AT 156TH STREET
NEW YORK

General Work

AMERICAN GEOGRAPHICAL SOCIETY

Officers and Councilors for 1932

Honorary President

JOHN GREENOUGH

President

JOHN H. FINLEY

Vice-Presidents

ALEXANDER HAMILTON RICE, M.D.
Term expires 1933

W. REDMOND CROSS
Term expires 1934

PHILIP W. HENRY
Term expires 1935

Domestic Corresponding Secretary

PAUL TUCKERMAN
Term expires 1935

Foreign Corresponding Secretary

FREDERIC C. WALCOTT
Term expires 1933

Recording Secretary

HAMILTON FISH KEAN
Term expires 1934

Treasurer

HENRY PARISH
Term expires 1933

Director and Editor

ISAIAH BOWMAN, PH.D.

Councilors

FREDERICK HELLMANN H. STUART HOTCHKISS
ARTHUR CURTISS JAMES OLIVER B. JAMES FRANK L. POLK
Terms expire 1933

PHILIP A. CARROLL CHARLES R. CRANE WILLIAM HALE HARKNESS
ARCHER M. HUNTINGTON WESLEY C. MITCHELL
Terms expire 1934

MADISON GRANT JOHN GREENOUGH ROLAND L. REDMOND
FRANKLIN D. ROOSEVELT F. TRUBEE DAVISON
Terms expire 1935

Editor of the Geographical Review

G. M. Wrigley, Ph.D.

Contributing Editors

Albert Perry Brigham, D.Sc., Colgate University (d. March 31)
William M. Davis, Hon. D.Sc., Ph.D., Harvard University
Harlan H. Barrows, Pd.M., The University of Chicago
Ellsworth Huntington, Ph.D., Yale University
Mark Jefferson, A.M., State Normal College, Ypsilanti, Mich.
Douglas Wilson Johnson, Ph.D., Columbia University
Lawrence Martin, Ph.D., Library of Congress
Alan G. Ogilvie, M.A., B.Sc., University of Edinburgh
H. A. Marmer, U. S. Coast and Geodetic Survey, Washington, D. C.
Robert Cushman Murphy, D.Sc., American Museum of Natural History

OBJECTS OF THE SOCIETY

The objects of the American Geographical Society are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The American Geographical Society is the oldest geographical society in the United States. When it was founded, in 1852, there were but twelve similar societies in the world. Now it exchanges publications with more than four hundred scientific associations. The Society publishes the *Geographical Review*, a quarterly magazine issued in January, April, July, and October, and a *Research Series* of comprehensive scope. It has also a large and growing library—one of the most important geographical libraries of the world; thousands of maps and charts; and a remarkable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries.

Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the book and map collections.

Three gold medals have been founded by the Society, the *Cullum Geographical Medal*, the *Charles P. Daly Medal*, and the *Samuel Finley Breese Morse Medal*, which are awarded from time to time to explorers, writers, and men of science who have contributed to the advance of geographical knowledge.

In addition it awards the *David Livingstone Centenary Medal*, founded by the Hispanic Society of America.

The qualifications for fellowship are an interest in exploration and travel, in the spread of geographical knowledge, and in the advancement of science.

A Fellow is entitled to the use of the library, reading and map rooms; to admission to all lectures and exhibitions; to the *Geographical Review;* and to occasional books and maps distributed by the Society.

The annual dues are ten dollars.

Form of Bequest

I do hereby give and bequeath to the American Geographical Society of New York _____

TABLE OF CONTENTS

PRINCIPAL ARTICLES

North America

Barry, J. Neilson. The First Explorers of the Columbia and Snake Rivers. (3 maps, 3 photographs) 443–456

Colton, Harold S. Sunset Crater: The Effect of a Volcanic Eruption on an Ancient Pueblo People. (4 maps, 5 photographs) 582–590

Dow, Clarence Lorenzo. Precipitation Maps of Nebraska. (19 maps in 4 figures) 457–463

Field, William Osgood, Jr. The Glaciers of the Northern Part of Prince William Sound, Alaska. (2 maps, 1 graph, 33 photographs) 361–388

Forbes, Alexander. Surveying in Northern Labrador. (2 maps, 25 photographs) 30–60

Hartshorne, Richard. The Twin City District: A Unique Form of Urban Landscape. (1 map, 4 photographs) 431–442

Porsild, A. E. Notes on Seiches and Currents in Great Bear Lake. (1 map, 1 graph) 474–477

Raup, H. F. Land Use and Water Supply Problems in Southern California: The Case of the Perris Valley. (3 maps, 1 diagram) 270–278

Whitney, Paul C. The Recent Retreat of McCarty Glacier, Alaska. (2 maps, 4 photographs) 389–391

Wright, John K. Sections and National Growth: An Atlas of the Historical Geography of the United States. (1 insert map) 353–360

Wright, John K. Voting Habits in the United States: A Note on Two Maps. (2 maps) 666–672

Zierer, Clifford M. Migratory Beekeepers of Southern California. (1 diagram, 4 photographs) 260–269

South America

Crist, Raymond E. Along the Llanos-Andes Border in Zamora, Venezuela. (2 maps, 1 diagram, 5 photographs) 411–422

James, Preston E. The Coffee Lands of Southeastern Brazil. (14 maps in 10 figures) 225–244

Notestein, Frank B., and Robert E. King. The Sierra Nevada de Cocuy. (1 map, 4 diagrams, 4 photographs) 423–430

Platt, Robert S. Six Farms in the Central Andes. (9 maps, 12 photographs) 245–259

Sheppard, George. The Salt Industry in Ecuador. (1 map, 4 photographs) 403–410

Shippee, Robert. The "Great Wall of Peru" and Other Aerial Photographic Studies by the Shippee-Johnson Peruvian Expedition. (1 map, 28 photographs) 1–29

Shippee, Robert. Lost Valleys of Peru: Results of the Shippee-Johnson Peruvian Expedition. (1 insert mosaic map, 1 text map, 17 photographs) . 562–581

EUROPE

Almagià, Roberto. Modern Albania: A Review. (1 map) 464–473

Dickinson, R. E. Some New Features of the Growth and Distribution of Population in England and Wales 279–285

AFRICA

Forbes, R. H. The Desiccation Problem in West Africa: The Capture of the Sourou by the Black Volta. (1 map, 1 graph, 9 photographs) . . . 97–106

Wellington, John H. Land Utilization in South Africa. (19 maps, 1 graph) 205–224

ASIA

Bishop, C. W. The Rise of Civilization in China with Reference to Its Geographical Aspects. (2 maps) 617–631

Dainelli, Giotto. Italia Pass in the Eastern Karakoram. (1 map, 11 photographs) 392–402

Lattimore, Owen. Chinese Colonization in Manchuria. (1 map) . . . 177–195

Lee, Hoon K. Korean Migrants in Manchuria. (5 maps) 196–204

Norin, Erik. Quaternary Climatic Changes within the Tarim Basin. (2 maps, 5 photographs) 591–598

Stevenson, Paul Huston. Notes on the Human Geography of the Chinese-Tibetan Borderland. (1 map, 2 diagrams, 10 photographs) 599–616

POLAR REGIONS

Boyd, Louise A. Fiords of East Greenland: A Photographic Reconnaissance throughout the Franz Josef and King Oscar Fiords. (1 insert map, 2 text maps, 35 photographs) 529–561

Collins, Henry B., Jr. Prehistoric Eskimo Culture on St. Lawrence Island. (1 map, 5 photographs) 107–119

Ellsworth, Lincoln, and Edward H. Smith. Report of the Preliminary Results of the Aeroarctic Expedition with *Graf Zeppelin*, 1931. (1 map, 16 photographs) 61–82

Hobbs, William H. Wilkes Land Rediscovered. (1 insert map, 1 text map, 5 map reproductions in 1 figure, 5 sketches in 3 figures) 632–655

Isachsen, Gunnar. Norwegian Explorations in the Antarctic, 1930–1931. (1 insert map, 4 text maps in 1 figure, 2 diagrams, 1 photograph) . . 83–96

THE OCEANS

Church, Phil E. Surface Temperatures of the Gulf Stream and Its Bordering Waters. (6 maps, 1 diagram) 286–293

GENERAL

Fleming, J. A. The Proposed Second International Polar Year, 1932–1933. (1 map) 131–134

Forbes, William T. M. A Note on Thornthwaite's New Classification of Climates. (1 diagram) 478–480

——International Geographical Congress, The, Paris, 1931 135–140

Johnson, Douglas. Principles of Marine Level Correlation. (7 diagrams) . 294–298

Johnson, **Douglas.** Rock Planes of Arid Regions. (1 map, 6 diagrams, 1 photograph) 656–665

Robertson, C. J. Geographical Trends in Sugar Production. (5 graphs) . 120–130

——Twenty-Eighth Annual Meeting of the Association of American Geographers 299–303

Wilkins, Sir **Hubert.** The International Congress of Transoceanic Aviators 673–675

DEPARTMENTS

American Geographical Society 141–144, 304–312, 481–483

Geographical Record 145–161 (1 map), 313–331 (1 map, 2 photographs), 484–501 (2 maps), 676–690 (2 maps)

Geographical Reviews 162–176, 332–352, 502–527, 691–704

Correspondence 527–528

Separate Illustrations

Map showing the Field of Operations of the *Norvegia* Antarctic Expedition of 1930–1931. 1 : 25,000,000 . . . . . Pl. I, opp. p. 96

Reproductions from Atlas of the Historical Geography of the United States . . . . . Pl. II, opp. p. 360

Map of the Heads of Kjerulf and Dickson Fiords, East Greenland, 1931. Approximately 1 : 50,000. With inset, The Route of the Louise A. Boyd Expedition in the Region of Franz Josef and King Oscar Fiords, 1931. 1 : 1,900,000 . . . . . Pl. III, opp. p. 560

Mosaic of a section of the Andagua Valley, Peru, made up of vertical photographs taken in the aerial survey of the valley. . . . . Pl. IV, opp. p. 580

[Map of] the Antarctic Discoveries of the Wilkes Expedition in 1840 in Comparison with the Work of Other Expeditions, Especially Those of Mawson. 1 : 3,350,000 . . . . . Pl. V, opp. p. 654

THE GEOGRAPHICAL REVIEW

CONTENTS FOR JANUARY, 1932

PAGE

The "Great Wall of Peru" and Other Aerial Photographic Studies by the Shippee-Johnson Peruvian Expedition . 1
By Robert Shippee

Surveying in Northern Labrador 30
By Alexander Forbes

Report of the Preliminary Results of the Aeroarctic Expedition with "Graf Zeppelin," 1931 61
By Lincoln Ellsworth and Edward H. Smith

Norwegian Explorations in the Antarctic, 1930–1931 . . 83
By Gunnar Isachsen

The Desiccation Problem in West Africa: The Capture of the Sourou by the Black Volta 97
By R. H. Forbes

Prehistoric Eskimo Culture on St. Lawrence Island . . . 107
By Henry B. Collins, Jr.

Geographical Trends in Sugar Production 120
By C. J. Robertson

The Proposed Second International Polar Year, 1932–1933 . 131
By J. A. Fleming

The International Geographical Congress, Paris, 1931 . . 135

American Geographical Society 141

Geographical Record (*listed on the next page*) 145

Geographical Reviews (*listed on the next page*) 162

The Society is not responsible for the opinions or statements of writers in the Review

PUBLISHED QUARTERLY BY THE AMERICAN GEOGRAPHICAL SOCIETY
BROADWAY AT 156TH STREET, NEW YORK, N. Y.

Price, $1.25 a number Five dollars a year

Entered as second-class matter, January 22, 1916, at the Post Office at New York, N. Y., under the Act of August 24, 1912

Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on July 30, 1918

GEOGRAPHICAL RECORD

NORTH AMERICA

The Great Plains. *By C. W. Thornthwaite* 145

SOUTH AMERICA

Rio de Janeiro. *By Preston E. James* 147

The Humboldt and Niño Currents. *By R. C. Murphy* 148

The Loma Formation of the West Coast Desert 150

AUSTRALASIA AND OCEANIA

Physiography of the Western MacDonnell Ranges 150

Crops of Coastal Queensland 151

POLAR REGIONS

Relation of the Work of the Mawson and Norwegian Antarctic Expeditions, 1930–1931 152

Novaya Zemlya and Franz Josef Land. *By J. V. Fuller* 155

The Wilkins-Ellsworth Transarctic Submarine Expedition 156

THE OCEANS

Arctic Ice and Its Distribution in the North Atlantic Ocean. *By H. A. Marmer* 157

HUMAN GEOGRAPHY

The Probable Origin of Alphabetic Writing 158

Forest Resources of the World 159

GEOGRAPHICAL NEWS

Geography at the British Association Centenary Meeting. *By S. W. Boggs* 159

OBITUARY

Robert DeCourcy Ward. *By C. F. Brooks* 161

GEOGRAPHICAL REVIEWS

D. B. COPLAND, edit. The Economics of Australian Transport 162

D. B. COPLAND, edit. An Economic Survey of Australia 162

EDWARD SHANN. An Economic History of Australia 162

PAUL PRIVAT-DESCHANEL. Océanie 162

GRIFFITH TAYLOR. Australia, Including Chapters on New Zealand and Neighboring Islands: A Geography Reader 162

ALFRED RÜHL. Das Standortsproblem in der Landwirtschafts-Geographie (Das Neuland Ostaustralien) 163

CHARLES FENNER. South Australia: A Geographical Study, Structural, Regional and Human. *By Griffith Taylor* 164

TOM GILL. Tropical Forests of the Caribbean. *By Samuel J. Record* 165

OTTO MAULL. Vom Itatiaya zum Paraguay: Ergebnisse und Erlebnisse einer Forschungsreise durch Mittelbrasilien. *By Preston E. James* 166

A. J. DE SAMPAIO. Phytogeographia do Brasil. *By Ernest G. Holt* 167

PHILIP AINSWORTH MEANS. Ancient Civilizations of the Andes. *By C. L. Chandler* 168

OWEN LATTIMORE. High Tartary 168

E. A. T. DUTTON. Kenya Mountain 169

LAURENCE MCKINLEY GOULD. Cold: The Record of an Antarctic Sledge Journey. *By Griffith Taylor* 170

W. O. BLANCHARD AND S. S. VISHER. Economic Geography of Europe. *By William Van Royen* 171

ROBERTO ALMAGIÀ, comp. Monumenta Italiae cartographica: riproduzioni di carte generali e regionali d'Italia dal secolo XIV al XVII 173

Atlante statistico italiano: Parte I: natalità, mortalità, densità della popolazione 173

Atlante internazionale del Touring Club Italiano 173

J. FRÜH. Geographie der Schweiz. *By Roderick Peattie and Eugene van Cleef* ... 175

MAURICE PARDÉ. Le régime du Mississippi. *By Robert M. Brown* 176

AMERICAN GEOGRAPHICAL SOCIETY PUBLICATIONS
PARTIAL LIST

A booklet describing the aims and activities of the Society may be obtained upon request

Bulletin **of the American Geographical Society, 1852–1915.** Fifty-one volumes. Known as *Bulletin* (1852–1856), *Proceedings* (1862–1864), *Journal* (1859–1860, 1870) *of the American Geographical and Statistical Society*, and as *Bulletin* (designated *Journal*, however, on title page of bound volumes to 1900) *of the American Geographical Society* (1872–1915). A set of the *Bulletin* from 1859 (complete except for four volumes that lack individual numbers) may be obtained for $150.00.

Index **to the Bulletin of the American Geographical Society, 1852–1915.** By ARTHUR A. BROOKS. With an historical and bibliographical note and a table showing the arrangement and composition of the series. xi and 242 pp. $2.00.

The **Geographical Review.** Vols. 1–20, 1916 to date. Successor to the *Bulletin of the American Geographical Society*. Monthly, 1916–1920; quarterly since 1921. Monthly numbers, 50 cents; quarterly numbers, $1.25; unbound volumes, 1916–1920 (two a year), $2.50; from 1921 (one a year), $5.00.

Index **to the Geographical Review, Vols. I–XV, 1916–1925.** By ARTHUR A. BROOKS. iii and 432 pp. 1926. $4.50, unbound; $5.25, bound.

China: **Land of Famine.** By WALTER H. MALLORY. With a Foreword by DR. JOHN H. FINLEY, President of the American Geographical Society. With 91 photographs and 12 maps. xvi and 199 pp. *Special Publication No. 6.* 1926. $4.00.

Problems **of Polar Research.** By 31 AUTHORS. 479 pp.; 96 maps, diagrams, and photographs. *Special Publication No. 7*, 1928. $5.00.

The **Geography of the Polar Regions.** By OTTO NORDENSKJÖLD and LUDWIG MECKING. 370 pp.; 135 maps, diagrams, and photographs. *Special Publication No. 8*, 1928. $4.00.

The **Coral Reef Problem.** By W. M. DAVIS. 596 pp.; 227 maps, diagrams, and photographs. *Special Publication No. 9*, 1928. $6.00.

Richard Hakluyt and the English Voyages. By GEORGE BRUNER PARKS. With an Introduction by JAMES WILLIAMSON. With 32 half-tone plates, mainly reproductions of portraits, drawings, old maps, title pages, manuscripts, etc. xvii and 289 pp. *Special Publication No. 10*, 1928. $5.00.

Brief **History of Polar Exploration Since the Introduction of Flying.** By W. L. G. JOERG. Accompanies A Physical Map of the Arctic and A Bathymetric Map of the Antarctic. 95 pp., 9 text maps. The Map of the Arctic, 1 : 20,000,000, 18 x 22 inches, shows relief (in five tints and hachures) and bathymetry (five tints), ice, ocean currents, and routes of exploration, with 11 insets on larger scales. The Map of the Antarctic, 1: 20,000,000, 23 x 25 inches, shows bathymetry (nine tints), spot heights on land, ice. *Special Publication No. 11*, 2nd, revised, edition, 1930. $5.00.

Peru **from the Air.** By LIEUTENANT GEORGE R. JOHNSON. With text and notes by RAYE R. PLATT. With 142 aerial photographs and 11 maps and sketches. xii and 159 pp. *Special Publication No. 12*, 1930. $5.00.

The **Pioneer Fringe.** By ISAIAH BOWMAN. With 175 photographs, and 75 maps and diagrams. xii and 361 pp. *Special Publication No. 13*, 1931. $4.00.

The Grand Coulee. By J HARLEN BRETZ. With 37 photographs, 16 line drawings, 8 stereoscopic views, and a separate map in color. x and 89 pp. *Special Publication No. 15*, 1932. $4.00.

Bering's Voyages: An Account of the Efforts of the Russians to Determine the Relation of Asia and America. By F. A. GOLDER. Vol. 1: **The Log Books and Official Reports of the First and Second Expeditions, 1725–1730 and 1733–1742.** With a chart of the second voyage, by Captain E. P. BERTHOLF. Vol. 2: G. W. **Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.** Translated and edited by F. A. GOLDER and LEONHARD STEJNEGER. *Research Series Nos. 1 (1922) and 2 (1925).* The volumes will not be sold separately. $8.00.

The Vegetation and Soils of Africa. By H. L. SHANTZ and C. F. MARBUT. With a section on land classification by the joint authors and a note on a rainfall map of Africa by J. B. KINCER. With 1 text map, 49 photographs, and a separate case of two maps (in color) 1:10,000,000, each with inset, 1:25,000,000, showing vegetation (on inset: soils) and land classification (on inset: annual rainfall). x and 263 pp. *Research Series No. 13*, 1923. $5.00.

Peopling the Argentine Pampa. By MARK JEFFERSON. With 55 photographs, 9 maps, and 4 diagrams. viii and 211 pp. *Research Series No. 16*, 1926. $4.00.

The Last Glaciation, With Special Reference to the Ice Retreat in Northeastern North America. By ERNST ANTEVS. 292 pp.; 30 maps and diagrams and 9 separate plates. *Research Series No. 17*, 1928. $3.50.

The Vinland Voyages. By MATTHIAS THÓRDARSON. Translated by THORSTINA JACKSON WALTERS and edited by HALLDÓR HERMANNSSON with an Introduction by VILHJÁLMUR STEFÁNSSON. xv and 76 pp.; 20 photographs and 3 maps. *Research Series No. 18*, 1930. $2.00.

Oriental Explorations and Studies, Nos. 1–6. By ALOIS MUSIL. No. 1. **The Northern Ḥeǧâz: A Topographical Itinerary.** xii and 374 pp. 1926. $7.00; No. 2. **Arabia Deserta: A Topographical Itinerary.** xvii and 631 pp. 1927. $8.00; No. 3. **The Middle Euphrates: A Topographical Itinerary.** xv and 426 pp. 1927. $8.00; No. 4. **Palmyrena: A Topographical Itinerary.** xiv and 367 pp. 1928. $7.00; No. 5. **Northern Neǧd: A Topographical Itinerary.** xiii and 368 pp. 1928. $7.00; No. 6. **The Manners and Customs of the Rwala Bedouins.** xiv and 712 pp. 1928. $8.00. Each volume fully illustrated with photographs, maps, drawings, and plans.

Map of Hispanic America, 1:1,000,000 [15.78 miles to 1 inch], Provisional Edition. 37 sheets of this map have now been published. An index map to the sheets may be obtained upon request. $2.00 each sheet.

The Leardo Map of the World of 1452 or 1453. Colored reproduction (measuring 28⅝ x 23½ inches, printed on sheet 35 x 30 inches) of map in the collections of the American Geographical Society. Accompanied by volume containing text by JOHN KIRTLAND WRIGHT describing the original map and a note by A. B. HOEN on the method of reproduction, with 3 photographs and 7 maps. viii and 90 pp. *Library Series No. 4.* 1927. $15.00 ($2.00 for text alone).

Separate Maps published in the *Geographical Review* and the *Bulletin of the American Geographical Society*, the majority in color. **25 cents each. A list will be sent upon request.**

THE
GEOGRAPHICAL REVIEW

VOL. XXII JANUARY, 1932 NO. 1

THE "GREAT WALL OF PERU" AND OTHER AERIAL PHOTOGRAPHIC STUDIES BY THE SHIPPEE-JOHNSON PERUVIAN EXPEDITION

Robert Shippee

THE appearance of "Peru from the Air,"[1] was followed by many requests for a continuation of the studies contained therein. In no field have the rewards of aerial survey been greater than in archeology, and the demand has been increasing for "more maps and more air photographs," as Crawford has phrased it. To meet this demand and the demands of geography were two of the chief objectives of the Shippee-Johnson Peruvian Expedition of 1931. The expedition planned to record the most important ancient sites of Peru by oblique and vertical photographs and mosaic maps. We had little expectation of making really new discoveries in a country where exploration has already revealed so much. We were quite unprepared for the "Great Wall," as it has been popularly termed.

THE GREAT WALL

While we were still operating from the base that we had established at Trujillo for the mapping of the well-known ruins of Chan-Chan, we made a flight with the photographic plane inland as far as the Marañón River and, on the return, circled southward around Mt. Huascarán and then followed the valley of the Santa River to the coast. Our course was over the edge of the foothills bordering the narrow upper valley of the river on the north. Johnson, co-leader and photographer of the expedition, watching for photographic subjects, noticed what appeared to be a wall flowing up and down over the ridges

[1] George R. Johnson and Raye R. Platt: Peru from the Air, *Amer. Geogr. Soc. Special Publ. No. 12*, New York, 1930.

Copyright, 1932, by the American Geographical Society of New York

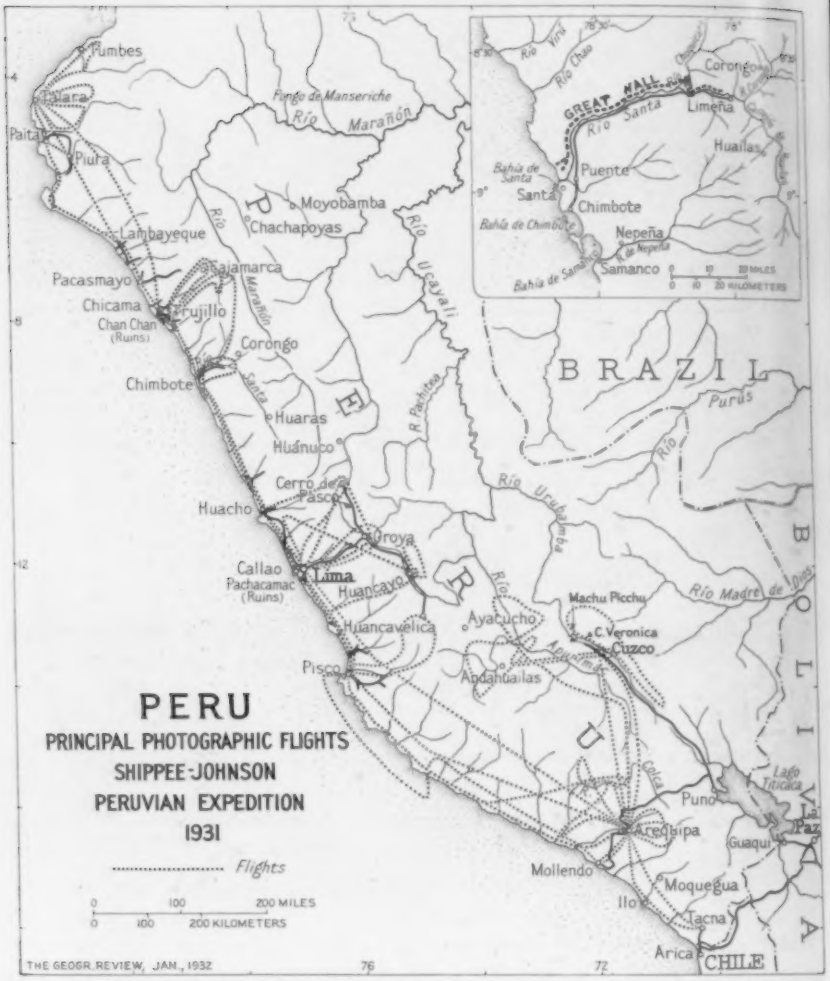


FIG. 1

beneath the plane, wondered for a moment as to the purpose of such a structure, decided that it was worth recording, and made a number of photographs of it. We hoped to be able to return later to make a more complete record of the wall but were not certain that we should have time to do so. The photographs, printed a few weeks later in our Lima laboratory, led to so much discussion, however, that just before our departure we arranged to make a special trip to relocate and examine the wall from both the air and the ground.

Johnson and I with our Peruvian observer, Captain Ceballos, flew to Chimbote in the photographic ship and established a temporary base there. Chimbote lies on one of the largest bays of the Peruvian coast, a few miles south of the Santa Valley, of which it is now the

FIG. 2—An aerial photograph of the west end of the Great Wall with the ocean in the background. There is a great confusion of walls throughout the delta of the Santa River. The photograph shows several in addition to the Great Wall itself, one of which parallels it for a considerable distance and then turns sharply to join it. At the seaward end of the more clearly defined sections of these two parallel walls can be seen the faint outlines of the ruined village mentioned in the text. The road at the right of the photograph is maintained by the Peruvian government in connection with a small salt-evaporating works located a few miles inland.

principal port. The little town in the lee of three tall, barren sand hills can boast of two things only—a natural harbor that would make the most ideal naval, aviation, or submarine base imaginable and a level, hard landing field that is used by the Peruvian commercial air lines.

The natives of Chimbote assured us that they knew about the wall, that they had heard of it from their ancestors, and that it was pre-Incaic. They could tell nothing, however, of its purpose or its history and, indeed, gave little real evidence that they had ever even heard of it.

From Chimbote the flight to the mouth of the Santa River was a

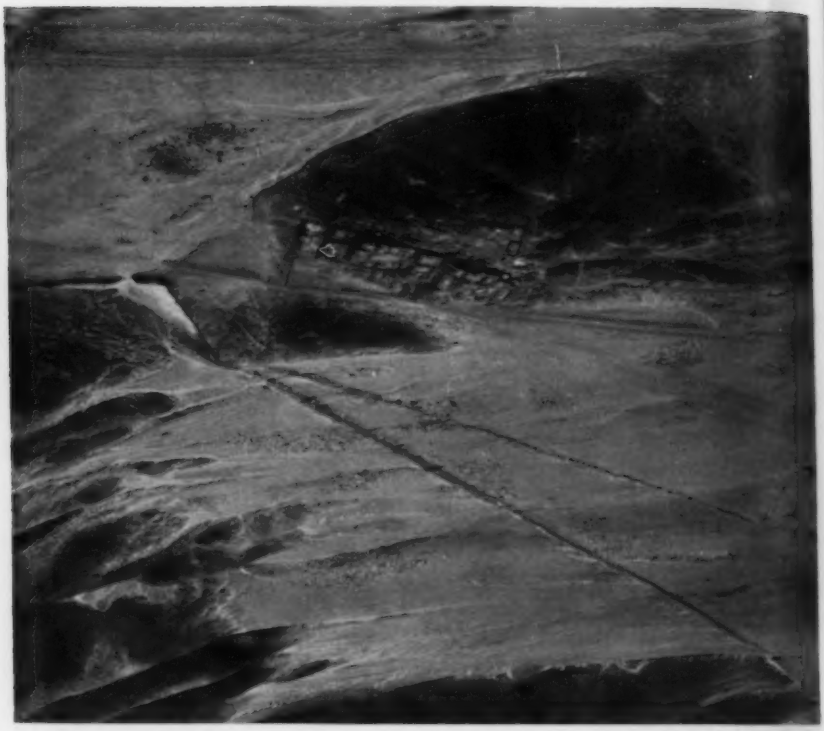


FIG. 3—A section of the wall a short distance up the valley from Figure 2. Here a secondary wall branches off from the main wall. On the hill in the foreground is one of the terrace fortresses of which many examples are to be found on the coastal hills that border the Santa delta. (For other examples see "Peru from the Air," Figs. 46 and 53.) The two roads—one in the immediate foreground and the other between the wall and the fortified hill—appear well-traveled, but it should be remembered that on the rainless Peruvian coast the tracks of a wheeled vehicle may remain clearly visible for years.

matter of a few minutes only. Turning inland from there we picked up the wall about five or six miles from the coast at the ruins of a small village. At that end the wall divides into two sections for a short distance as shown in Figure 2. It may have once extended to the shore line; but, if it did, it has been broken down, and the stones have either been removed for other building purposes or covered by the drifting sand.

From the ruined village, itself all but lost under the sand, the wall leads away up the north side of the river, first across the level, sandy plain of the river delta and then, as the valley narrows, over the edge of the foothills bordering the valley. As the foothill ridges become sharper and steeper, the wall rises and dips and in places is turned slightly from its generally straight course. Its distance from the river is in general about a mile and a half, although in one place at least it dips down close to the edge of the river bed. In places it blends so well with the background as to be almost indistinguishable.

It was impossible to make an accurate check on the distance we

FIG. 4—A section of the Great Wall cutting across the dry bed of a tributary of the Santa River a short distance from the coast.

followed the wall, for the air was so unusually rough that, as we approached the Andes, we had to circle and climb for more and more altitude; but we followed it for at least forty miles and possibly more. Then we lost it. We had already passed over several short breaks, but this time we failed to pick it up again. The light, which was poor when we started—for the flight was made in August, a winter month when the coastal valleys are nearly always overcast and often filled solid with fog—was getting rapidly worse; so we headed back for Chimbote taking only a few minutes out to get more close-ups of the forts on both sides of the wall.

It so happened that none of our first photographs showed any of these forts. But, on this second flight we noticed at irregular intervals on both sides of the wall, but at short distances from it, a series of small forts—some circular and some rectangular—most of which were more or less inset in the top of small hills so as to be quite invisible from the valley floor. Those on the south side, and they were the larger, were located in the hills on the south side of the Santa River opposite the wall. We believe that we located and photographed all of these forts—a total of fourteen. The largest one appeared to be

FIG. 5—The Great Wall here crosses and recrosses the dry stream bed of a tributary of the Santa River.

about 300 feet by 200 feet, with walls about fifteen feet high and perhaps five feet thick, and was of piled stone construction. A few of the others were of the same construction, but most of them appeared to be of adobe.

At Chimbote we at once began preparation for a trip to the wall overland. From a rough sketch made while in the air we figured that we could reach at least the western end of the wall by automobile. There is a bridge over the Santa near its mouth, and, once on the other side, it would be simply a question of how far the car could plow through the sand. The next morning we loaded our equipment into an old Ford and started off on a trip that was to take five hours

FIG. 6—A section of the Great Wall built on the crest of one of the long spurs of the Andes that border the Santa Valley on the north.

of bumping over crude roads, slithering down muddy cow paths, and pushing through deep sand. Steering our course by a method of "dead reckoning" especially devised for the occasion, we at last reached the sand-covered ruins of the little village at the end of the wall. It was just by chance that we did not miss them entirely. From the air we had been able to make out the plan of the streets and the walls of the separate houses. From the ground we saw nothing but a few sand-covered ridges.

Just beyond these ridges, which were crumbled adobe walls buried beneath centuries of drifted sand, we saw the wall stretching away to the horizon. We followed along it for several miles. Then the

FIG. 7—One of the square adobe fortresses that guard the wall on the south side of the Santa River.

valley began to narrow and the cross ridges to dip more sharply down to it. The Ford could go no farther. We struggled on afoot for another mile, lugging the cameras and stopping at intervals for still and motion pictures showing construction details and the character of the terrain on which the wall stands.

The wall, as far as we followed it, now averages about seven feet in height. It is built of broken rocks set together with adobe cement, and, where it has not been greatly disturbed, its outer surface is so well chinked with small rocks that it would be practically impossible to scale it without ladders. In occasional places, as seen from the air, the wall must still be twenty or thirty feet high where it crosses gullies. We found it impossible to make anything like accurate measurements. The rocks that have slipped from the top with the

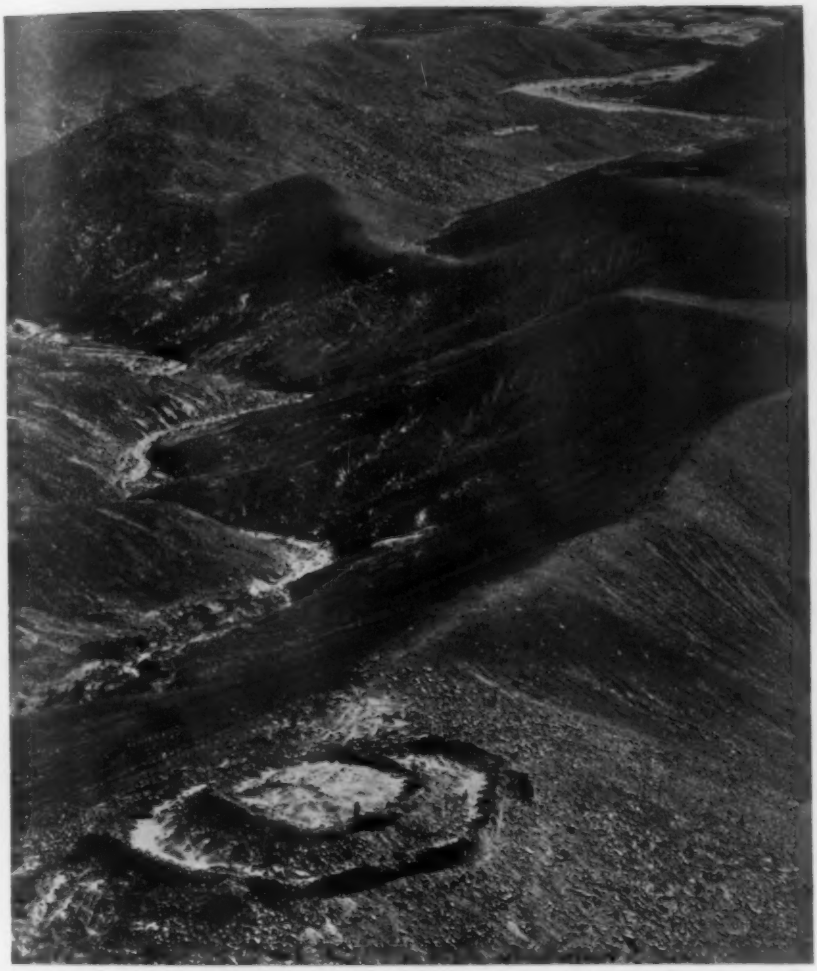


FIG. 8—This photograph has caught two of the hilltop fortresses that guard the south bank of the Santa River. Both are of the adobe construction characteristic of most of the forts on both sides of the river.

beating of the winds and the occasional rains spread away for a considerable distance on either side of the wall and aid the drifted sand in obscuring its base. We estimated that, in its original state, it was about twelve or fifteen feet thick at the base and was built to taper upward to an average height of twelve or fifteen feet.

ORIGIN OF THE WALL

We were unable to come to any conclusion concerning the origin of the wall. As Dr. A. L. Kroeber remarks, that will require careful examination by an archeologist familiar with different types of construction and able to interpret potsherds or other fragments that

FIG. 9—A section of the wall near its western end where it crosses the delta of the Santa River.

may be found in association with the wall. If we had had time to carry our ground explorations farther and to investigate the forts we might have found more definite indications as to its history; but we had already spent eight and a half months in Peru instead of the five months originally planned.

Further exploration to determine how far the wall extends into the Andes would be especially worth while. We estimate that when we finally lost sight of the wall we were in the neighborhood of Corongo. Wiener[2] mentions strongly fortified hills in the Corongo region. We have, therefore, the possibility of a defensive wall joining the fortifications of the Corongo region with those at the mouth of the Santa River.

Clearly the wall with its double line of forts was erected as a defensive barrier. If it is true that the fortified hilltops at Paramonga, some fifty miles farther south, mark the southern limits of the domain of the Great Chimú, there are many guesses that can be made as to the origin and purpose of the wall. It may be an intertribal defense that antedates the consolidation of the Chimú kingdom. Or it may be a secondary line of defense erected by the Chimú against the Inca invader. If the latter is the case it may explain why, as tradition says, the Inca abandoned his invasions of the Chimú kingdom from the south along the coast and finally conquered it by advancing his armies through the Andes and laying direct siege to Chan-Chan, the Chimú capital.

The suggestion has been advanced by Dr. R. L. Olson of the University of California that the wall may represent one of a series of defense structures built by the Chimú as they extended their territory to the north and south.[3] While engaged in field work in this part of Peru two years ago Dr. Olson noted a number of walls in the

[2] Charles Wiener: Pérou et Bolivie, Paris, 1880, p. 177.

[3] From a preliminary statement sent to the American Geographical Society at the instance of Dr. A. L. Kroeber.

FIG. 10—A section of the wall near its western end showing the character of the construction.

Chao Valley, about twenty miles north of the Santa Valley, mostly fragmentary and running for short distances only. He describes a larger wall cutting across the pampa between Trujillo and Chicama that was built presumably for the defense of Chan-Chan.

Professor Marshall H. Saville suggests that the wall may have been erected by the Chimú or pre-Chimú occupants of the Santa Valley to prevent the neighboring tribes on the north or possible invaders from the north from gaining access to the river where by damming or otherwise diverting the stream they could cut off the water supply from the great aqueducts, still largely in fairly good repair, that irrigated the densely-peopled Santa delta. In connection with this suggestion may be cited Montesinos' account that the Inca finally conquered the Great Chimú by cutting off his water supply.[4] It may have been the supply to the Santa Valley that was cut off by the Inca, since Montesinos does not state which valley it was in which the Chimú finally capitulated, while Garcilasso de la Vega[5] says that it was the Santa Valley, although he makes no mention of the cutting off of the water supply.

Dr. Julio C. Tello, Director of the Archeological Museum of the University of San Marcos and a leading authority on the Inca and pre-Inca civilizations, states in reply to a letter addressed to him by the American Geographical Society that not only had he never heard of the wall until it was reported by the Shippee-Johnson Expedition but that he has been unable to find anyone among the owners of the large haciendas in the Santa Valley who knows anything of it. Dr. Tello reports that he has discovered several walls similar to the Great Wall of the Santa Valley in valleys south of Lima, although

[4] Fernando Montesinos: Memorias antiguas historiales del Peru, translated and edited by Philip Ainsworth Means, *Hakluyt Soc. Publs.*, Ser. 2, Vol. 48, London, 1920, p. 48.

[5] Garcilasso de la Vega: First Part of the Royal Commentaries of the Yncas, translated and edited by Clements R. Markham, *Hakluyt Soc. Publs.*, Ser. 1, No. 45 (2 vols.), London, 1871, Vol. 2, pp. 196–201.

none of them are more than a few kilometers in length. He also mentions the wall between Trujillo and Chicama described by Dr. Olson, but offers no suggestions as to the possible purpose of this or others of what he describes as the "mysterious walls of Peru."

It is still hard for us to believe that we have actually made a new

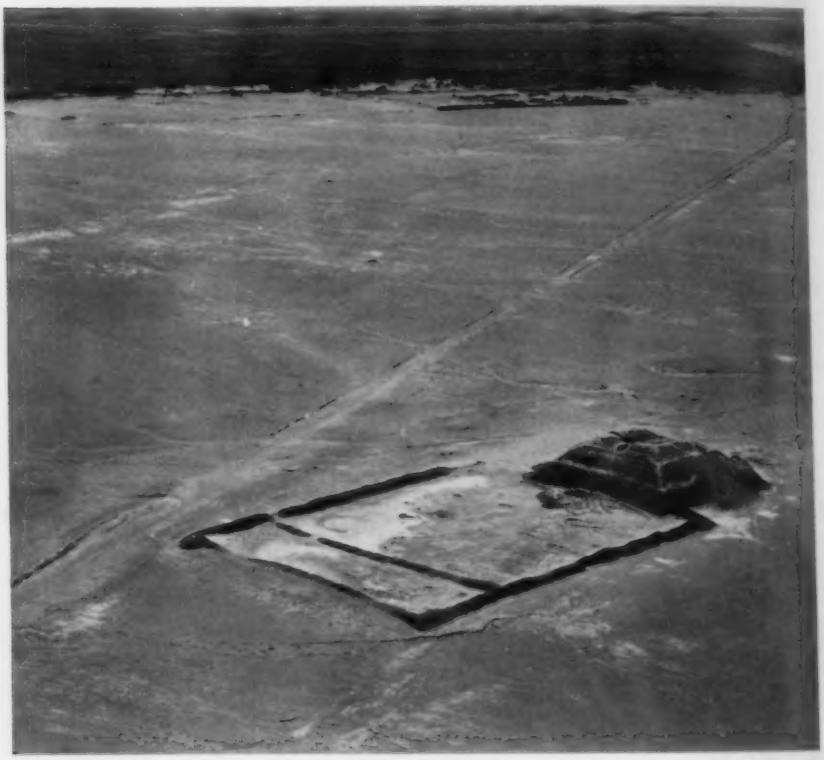


FIG. 11—Ruins of a temple in the Chicama Valley with a section of the walled road said to have been built along the coast by the Incas as a part of their system of highway connections between Cuzco and Quito.

discovery of such evident importance in a region whose ruins have been for more than seventy-five years the subject of frequent and careful explorations by a long list of noted archeologists, many of whom have made their reputations there. From the air the wall and its forts are so striking a feature of the landscape that it is difficult to understand how they could have so long escaped notice from the ground. That this is the case seems less astonishing, however, when one considers that, even though the wall were noticed at its western end where it crosses the delta of the Santa River, it would appear only as one more wall in a region filled not only with the ruins of elaborate fortifications—fortified hills and defensive walls of various sorts—but also with the remains of cities, towns, and extensive irriga-

FIG. 12

FIG. 13

FIG. 12—The city of Trujillo, near which lie the ruins of Chan-Chan.

FIG. 13—A section of one of the vertical photographs made in the aerial survey of Chan-Chan. The scale of the photograph is about 1 : 15,000.

tion works. Only when one looks down upon the wall from the air and thus is able to see long sections of it can one realize that it is a feature quite distinct from the short sections of wall characteristic of the Santa delta. This broad view presented to observer and camera is what makes the airplane so important an instrument in modern exploration. The aerial observer is afforded, and the aerial camera records frequently in a single exposure, a synthesis of details whose relationships might otherwise never be discovered.

Surveys of Chan-Chan and Pachacamac

The base at Trujillo from which we made our first flight over the Great Wall had been established for the purpose of making a mosaic map of the ruins of Chan-Chan, the capital of the kingdom of the Great Chimú whom the Incas conquered shortly before the Spanish conquest. The ruins have recently been described by Major Otto Holstein in an article in the *Geographical Review*. He particularly called attention to the disastrous effect of the rains of 1925 and urged that systematic study of the site be made without delay.[6] Johnson had had it in mind for some time to make an accurate record of these ruins, based on a good triangulation, before another rainy year like that of 1925 had completed their destruction.

The ruins occupy an area of about eleven square miles. From a base line of 3600 feet two of us with a detail of soldiers lent us by the Trujillo garrison triangulated the entire area and laid white lime markers. It was difficult to work with any speed and still obtain the degree of accuracy for which we were striving, for the high adobe walls and the rounded bulks of the *huacas* so interfered with the sights that we had to choose all points with great care. Three and a half days were required for the completion of the triangulation.

On the other hand, in forty minutes from the time the plane took off for the aerial survey the wheels again touched ground with the survey completed. Furthermore, when we came to the assembling of the mosaic, we found that the only corrections our photographs needed were those required to offset the slight variations in the altitude of the plane while the photographs were being made—variations due to the airplane rising or settling in updrafts and downdrafts. In nine cases out of ten the accuracy of an aerial survey of such a small area made in a country as flat as the site of Chan-Chan would be sufficient without ground control.

The second of the surveys of archeological sites which our original plans called for was that of the ruins of Pachacamac, a few minutes' ride from Lima by automobile. Because they are near Lima these ruins are perhaps better known to tourists than any others in the

[6] Otto Holstein: Chan-Chan: Capital of the Great Chimu, *Geogr. Rev.*, Vol. 17, 1927, pp. 36–61.

coastal region of Peru. They are the remains of the pre-Inca temple of the Creator-God Pachacamac and the Inca temple of the Sun and the two villages built in connection with them, one of which was used by the permanent residents of the place and the other by pilgrims

FIG. 14—View from the north of the ruins of Pachacamac in the Lurin Valley. The large block of ruins near the top of the picture is the Sun Temple built by the Incas. Immediately below are the ruins of the much older temple of Pachacamac, the chief deity of the region before the Inca conquest. In the foreground are the remains of the villages established in connection with the shrine. Temples and town stand close to the sea on and around a group of low hills above the irrigable level of the valley. The braided course of the river that waters the valley is seen at the left.

who are believed to have assembled at this shrine from all parts of the empire.

Flying at an altitude of 10,000 feet we mapped the ruins in a few minutes. Then, going in by automobiles, we made numerous still and motion pictures from the ground.

WORK IN THE CUZCO REGION

While we were making preliminary reconnaissance of the Colca Valley word came that a landing field had been prepared for us at Cuzco. We decided that the work there had best be undertaken at once before the rainy season set in in the sierra.

On the flight to Cuzco we had our only serious mishap. We took off from Arequipa on May 21. En route the two planes became separated. I landed my ship, the *Lima*, at the Cuzco field located at

FIG. 15—An aerial view of the site of the ruins of Machu Picchu on the top of a forest-covered hill rising by sheer ascent nearly 4000 feet above a gorge of the Urubamba River to 10,300 feet above the sea.

Anta, a few miles from the city, on schedule; but the photographic ship, the *Washington*, did not show up on time, and a three-hour reconnaissance flight back to the point where we separated failed to locate her. At midnight, however, word came through from the Andahuaylas telegraph post that the missing ship had been landed on the Huancabamba pampa about 90 miles west of Cuzco, and that, although the crew was unhurt, a wing tip had been damaged.

The following morning we flew the *Lima* from Cuzco to Andahuaylas, taking extra gas and repair materials. After an enforced

FIG. 16—A closer view of the hilltop ruins of Machu Picchu showing the heavy forest growth that has sprung up among them since Bingham cleared it away in 1912.

night on the pampa with a temperature but a few degrees above zero we finally got both planes back to the Anta field. The damaged wing was changed to the *Lima* so that the photographic ship might continue its work with two good wings. Then we attempted to take off the *Lima* for a return flight to our home base where the wing could be rebuilt. Unfortunately the field proved too small for the crippled ship, which was so badly damaged at the take-off that we found it inadvisable to attempt to repair it in Peru.

Our work went on with the *Washington*, now forced to do all the flying. Photographs were made from the air of various archeological

sites in the Cuzco region, among them Machu Picchu. These ruins in the Urubamba Valley, "two days hard journey" on the ground or forty-five minutes by air from Cuzco have been made known to the world by the labors of Dr. Hiram Bingham. The site is magnificent—above "a stupendous canyon whose rim is more than a mile above the

FIG. 17—A group of amphitheaters on the Maras Pampa about fifteen miles northwest of Cuzco that seem to have escaped the notice of archeological explorers of the region.

river . . . whose precipices are frequently a thousand feet sheer."[7] An incomparable view of the Inca citadel is obtained from the air (Figs. 15 and 16).

Another day was spent in photographing Fort Sacsahuaman on the heights above Cuzco, but perhaps the most interesting of our aerial photographs in this region are those of the group of amphitheaters that we came upon in the Maras Pampa about fifteen miles northwest of Cuzco (Fig. 17). The priests in a church in Cuzco knew of their existence and said they had been used by the Incas for religious presentations during their fiestas. We have, however, not been able to find any mention of them in the literature on the region.

SURVEY OF THE TALARA OIL FIELDS

Our aerial survey of the holdings of the International Petroleum Company at Talara, northern Peru, was made in February. It

[7] Hiram Bingham: Machu Picchu: A Citadel of the Incas, New Haven, 1930, p. 39.

FIG. 18

FIG. 19

FIG. 18—Hillside farms near the village of Samne in the Otuzco Valley northeast of Trujillo.

FIG. 19—A section of the Urubamba Valley near Cuzco with the remarkably well-preserved terraces and formal gardens in front of the ruins of what is believed to have been the palace of an Inca noble. The river is still confined to its bed by stone dikes built before the Conquest.

seemed to us that the flat, desert country of the Talara fields would be easy to map from the air. Certainly little correction would be necessary in assembling a mosaic from the photographs. Several

FIG. 20—A remarkable vertical photograph of a simple stream pattern in the desert *tablazo* near Talara.

problems cropped up, however, when the work began: how best to cover the area with ground control; how best to give some relief to the mosaic, to make depressions look like depressions, and oil rigs stand out as other than mere dots on the sand. Clouds also hindered us, since to cover the extensive area economically we had to fly at 15,000 feet, and even on the arid Peruvian coast there are few really cloudless days.

For ground control, in addition to white lime markers at all our triangulation points, we made use of a system developed by Johnson several years ago in which a network of oblique sheets is used to tie in various landmarks so that in making the mosaic for the vertical photographs each point can be definitely aligned. By flying late in

the afternoon and for short periods only we utilized the shadows cast by the oil rigs and thus obtained a remarkably realistic picture of the fields.

The Talara engineers, because of previous experience with a careless job of aerial mapping, were frankly skeptical of the accuracy of

FIG. 21—A view of the great crescentic sand dunes that dot the high desert pampas on the air route between Mollendo and Arequipa. An idea of their size may be had by comparing the one in the foreground with the Bellanca cabin monoplane moored within the inner curve.

our work. On checking the first test layouts of the points against their own maps, one section was declared to be inaccurate. A transit crew was put at work to check that particular area, and our hastily assembled map was proved accurate within a few inches.

FLIGHT TO HUANCAYO

We had hoped to be able to get into the lowlands beyond the Andes to make a test of aerial survey methods in heavily-forested country; but the delays incident on political disturbances following the overthrow of the Leguia government prevented us from so doing. We did, however, make two trips to Huancayo in the upper Jauja Valley—one by rail to get the lay of the land and one by air immediately after the completion of the work at Pachacamac. On our trip to Huancayo by rail we were fortunate enough to locate a good landing field—a strip of road, fairly smooth and sufficiently long to assure safety in landing a ship at 11,000 feet altitude. It was near the Car-

FIG. 22—Casapalca, an important mining town at an elevation of 13,600 feet in the upper Rimac Valley. In the background is the high, snow-capped range through which the Central Railway of Peru passes on its way to Oroya by a tunnel at an altitude of 15,665 feet above sea level.

negie Terrestrial Magnetism Observatory, where we were also assured by Mr. Ledig, chief of the observatory, of comfortable quarters and the use of a dark room.

Heavy clouds rendered futile the first three attempts to get through to Huancayo by air. On the fourth attempt, however, on April 21, we were successful. It was our first experience in high altitude landing; later we were to make landings at still higher altitudes, but as a first attempt Huancayo will always be remembered. In landing at such heights the speed of the plane is nearly doubled. That is, instead of the wheels touching the ground at forty or fifty miles an hour they touch at a speed of nearly a hundred. In the thin air one has to be careful with the controls. The plane will stall with no warning, and sharp turns are dangerous unless the speed is kept well above the minimum.

On account of bad weather conditions we were delayed at Huancayo for eight days. The wait for good weather was well worth while, however. The oblique photographs of the glaciers of that region stand out as the best of our entire photographic collection. It

would be impossible to obtain such pictures from the ground.

Work in the Arequipa Region

For the work in the south we were able to use the Akeley motion-picture camera which we had hitherto not been permitted to operate; and Mr. W. O. Runcie, an expert motion-picture man of long experience in Peru, was engaged to help with the photography. On May 4 both ships lifted their heavy loads from Faucett's Field at Lima and five hours later landed safely at Arequipa, 7500 feet above sea level. For the next week we flew steadily, most of the time with the aid of oxygen. Motion pictures and stills were made of El Misti, Ubinas, the Nudo de Ampato, and the high snow caps of Coropuna. Staying aloft for periods of four and five hours, the planes climbed as high as 24,000 feet, circled over, around, and actually inside of the craters of El Misti (Fig. 29) and Ubinas, and landed on the high pampa, so-called, back of the coast range between Arequipa and Mollendo for a brief examination of the famous La Joya crescentic sand dunes (Fig. 21)—dunes that move an

Fig. 23—The mining village of Samne in the Otuzco Valley northeast of Trujillo.

In the deep gorge in the foreground flows the Otuzco River, the principal headwater tributary of the Moche which waters the rich coastal valley where the Great Chimú built his capital.

FIG. 24—Cerro Veronica, a snow-capped peak 19,342 feet high, that rises above the gorge of the Urubamba River about thirty miles northwest of Cuzco. One of the old Inca routes from Cuzco to the lower Urubamba Valley was by way of a high pass immediately north of this peak.

average of sixty feet a year and cover the pampas as far south as Tacna.

We also made a preliminary examination from the air of the Colca Valley, some seventy miles north of Arequipa, where fourteen "lost" villages nestle on the floor of a steep gorge. Apparently they have long since been all but forgotten until Johnson photographed them on a flight made in 1929 when he was chief photographer of the Peruvian Naval Air Force.

In fact a desire to revisit and study this valley was our first purpose in organizing the expedition. After our return from Cuzco a land party spent six weeks in the valley, a landing field was constructed, and the whole upper valley was surveyed from the air. The work in the Colca Valley with that in the near-by Andagua Valley, where

FIG. 25—A view of the summit of Cerro Veronica from the opposite side of that shown in Figure 24.

some forty small volcanoes, apparently hitherto unknown, were located and photographed, will be related in another article in the *Geographical Review*.

STATIC TESTS

A brief account of our difficulties with "static" may be of use to others doing photographic work under similar conditions. We found on returning to our Lima laboratory after our work in the north that a good many of the photographs taken at high altitudes were spoiled by "static." Streaks and lines crossed and recrossed many of the negatives so as to make them valueless. This is an unsolved problem of aerial photography. Static electricity is obviously the cause, but the exact explanation of its presence and a remedy for its effect are still being sought by photographic experts. It occurs most fre-

FIG. 26—Glaciers and glacial lake on Cerro Chuspicocha, one of the many snow-capped peaks near Huancayo. Because of the difficulty of reaching this section of the Andes from the coast the series from which this photograph and Figure 27 were selected ranks high among the achievements of the expedition.

quently at high altitudes in rarified air where static conditions reach a maximum. The static reaches the inside of the aerial camera or is generated there—as by the rapid unrolling of the films—and the electrical sparks and flashes leave their image on the negative.

Experiments in eliminating this phenomenon have been made in the United States, in Canada, and in Europe not only by commercial organizations but also by government research laboratories. Progress in this experimentation is greatly retarded by the fact that static conditions cannot be accurately reproduced in the laboratory but must be encountered in the air. On some flights roll after roll of aerial film may be exposed with no trace of static. Then on the very next flight dozens of photographs will show its effect.

Although we failed to eliminate the static, we did learn enough about the conditions under which it was most prevalent materially to cut down the number of wasted exposures. Equipped with oxygen for pilot and photographer we made test flights at altitudes up to 24,000

feet above the sea. In the Fairchild aerial camera Johnson installed insulating devices, grounding connections, moisture pads, and a dozen or more similar gadgets until the interior of the camera would hold no more.

From those experiments we came to certain conclusions that seemed to be quite definitely established. We got no static effects in photographs made at altitudes up to 14,000 feet provided that the exposures were made on the way up and not on the descent. For some unknown reason there was very little static in vertical photographs, although the reason may be because in the vertical photography the camera was mounted in the ship and not exposed to the outside air as directly as when it was held by hand out of the window in the making of obliques. Whether the sky was clear or overcast seemed to make little difference. Rewinding the film as slowly as possible helped to a slight degree. And, finally, even when the entire roll of 110 photographs was exposed at extreme altitudes the first fifty exposures were generally free from static. The last two experi-

FIG. 27—Cerro Lasuntay near Huancayo. The snowfields and glaciers of this section are among the largest in the Peruvian Andes; yet they are rarely mentioned in descriptions of the Peruvian landscape. Only from the air could such detailed and comprehensive photographs be obtained.

FIG. 28

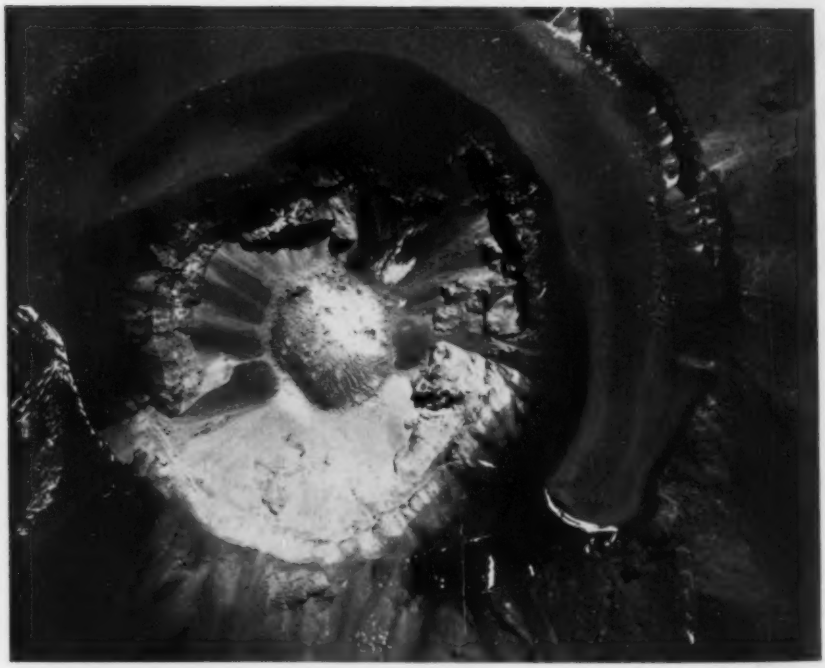


FIG. 29

FIG. 28—Ubinas Volcano (17,380 feet), a little-known cone about thirty-five miles east of El Misti. The diameter of its crater is nearly three times that of El Misti.

FIG. 29—Looking directly down into the crater of El Misti (19,262 feet) from an elevation of 21,000 feet. The plane was flown down below the rims of the craters of both El Misti and Ubinas.

ments are to us the most significant. It seems logical to conclude from them that the speed with which the film is unrolled from the spool to some extent regulates the generation of static; for, as the end of the roll is reached the spool turns faster and faster as the film is pulled away from a core of steadily decreasing circumference. It is our belief that if the film were cut to fifty exposures and rolled on a thicker spool, the occurrence of static would be greatly reduced.

All our lower shots were made on the way up not only as a result of these experiments but also because we found that in coming down from high altitudes the lens of the camera became so coated with moisture that it was impossible to get clear exposures, as no amount of wiping would clear it.

Summary

The Shippee-Johnson Peruvian Expedition, with Lieutenant George R. Johnson and myself as co-leaders, Irving Hay as pilot, Valentine Van Keuren as civil engineer, and Max Distel as mechanic, was organized to carry out a number of projects of aerial photography and surveying conceived by Johnson during his service with the Peruvian Naval Air Service.

The work of the expedition except for that done among the people of the Colca Valley and based on a questionnaire prepared at the American Geographical Society was almost exclusively photographic. Our equipment was two Bellanca cabin monoplanes, one of which was especially equipped for photographic work of all kinds, and a full complement of aerial cameras and motion-picture machines of the latest type. Our records are not in written words but in the photographs we have brought back.

The *Washington* was in the air 351 hours, the *Lima* 103½ hours; 40 hours were flown above 17,000 feet with the use of oxygen. The highest altitude attained, just east of Lima, May 1, was 24,700 feet: the temperature at this altitude was 4° F. (60° F. at 8000 feet).

Complete aerial surveys were made of Talara at an altitude of 15,000 feet; of Chan-Chan at 8000 and 4000 feet; of Pachacamac at 2000 and 10,000 feet; of the Colca Valley at 21,000 feet; and of the Andagua Valley at 20,000 feet. The oblique and vertical aerial photographs totaled 3000; ground photographs, 1000; motion pictures, 25,000 feet of standard 35 millimeters, 5000 feet of 16 millimeters.

SURVEYING IN NORTHERN LABRADOR

Alexander Forbes

FIG. 1—Area of survey ruled: see Figure 2.

THIS plan of surveying in northern Labrador originated in the course of a conversation with Sir Wilfred Grenfell several years ago. "If you like cruising," he said, "why don't you come and map one of the uncharted fiords in Labrador?"

The Labrador coast, extending about 600 miles from the Strait of Belle Isle to Cape Chidley, may be roughly divided in thirds. The first third as far north as Indian Harbor has been fairly well surveyed, and the charts are reasonably accurate for the purposes of the coast-wise navigator. This region is frequented by the fishing fleet; inhabited houses are occasionally seen on the shore, and here are several hospitals and dispensaries of the Grenfell Mission. The remaining two-thirds has not been surveyed, except for local surveys of some eight harbors. The charts become increasingly crude as the coast line is followed north, confessing to uncertainties by showing the shore as a dotted line. North of Nain the largest scale given on the Admiralty charts is 1:2,260,000. The middle third, from Indian Harbor to Cape Mugford, is characterized by innumerable islands, with no very high land close to the sea, except the Kiglapait Mountains. The mail steamer traverses this region as far as Hopedale about twice a month in summer. A few small settlements are found, and there are five Hudson's Bay Company posts, at three of which, Mokkovik, Hopedale, and Nain, are Moravian Missions.

The last third of the coast, from Cape Mugford to Cape Chidley, is mountainous, the shores are steep and bold, deep fiords extend inward through the mountains, and there are relatively few islands. No mail steamer operates along this coast; and the sole settlement, Hebron, where a Moravian Mission and a Hudson's Bay Company post serve the Eskimo population, is supplied only by the Hudson's

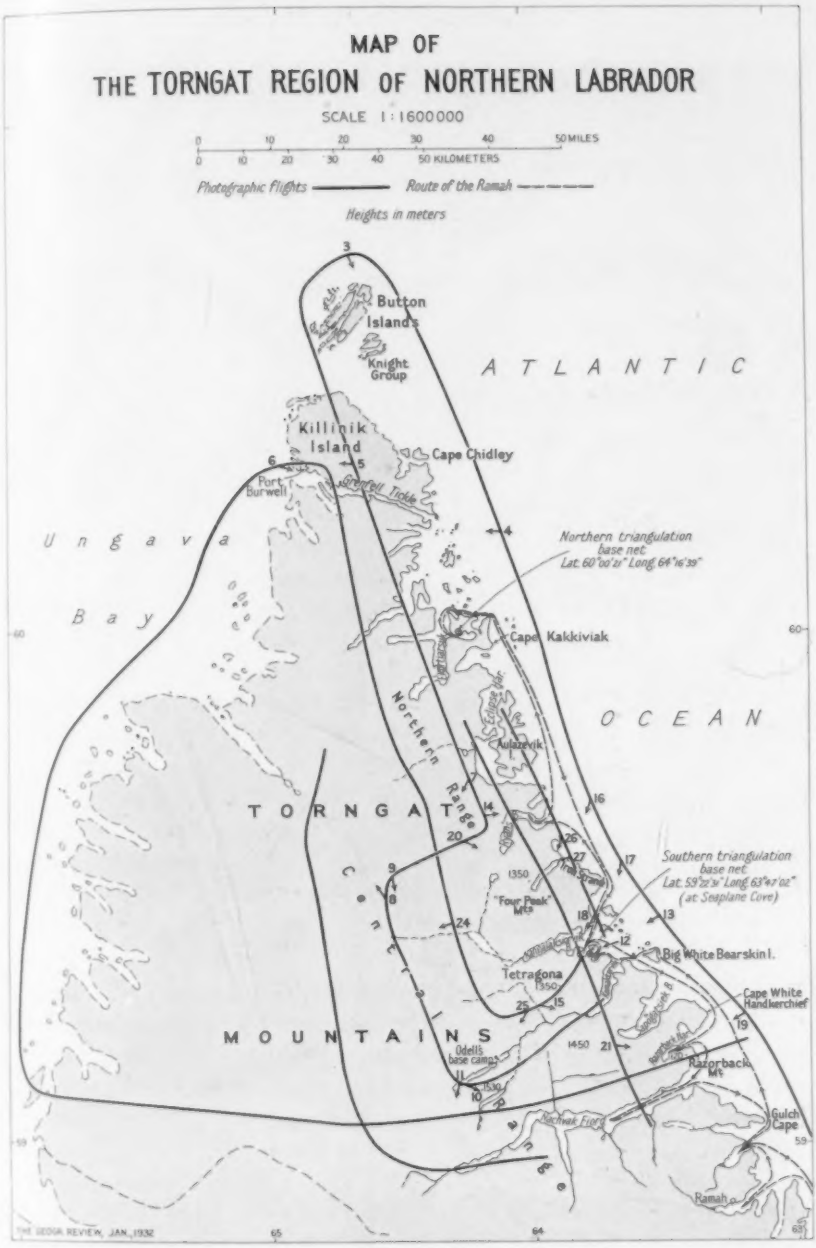


FIG. 2—Map of northern Labrador showing the routes of the *Ramah* and of the various flights during which the survey photographs were taken. The positions of photographs reproduced in the article are also indicated on the map, numbers on the map corresponding with figure numbers in the text. The ground control was used in making the map as a basis for determining the relative positions of the major features, and the east coast was sketched in by eye from examination of some of the photographs. It should, however, be understood that the coast line delineation is only provisional, as the work of constructing the final map, which will be the outcome of the survey, is not sufficiently advanced to use the photographic material for making actual measurements. Scale of the map 1:1,600,000.

FIG. 3—Button Islands in the foreground, Knight group in middle distance. Cape Chidley is the point of land in the background. Looking southeast. August 3, 1931.

Bay Company boats, which visit the station two or three times in the summer. To this northern third the fishing boats sometimes go when the catch is poor farther south.

West of Cape Chidley, at the northeast corner of Ungava Bay, is Port Burwell, a Canadian government station, but this is in Canadian territory.

PLANS AND EQUIPMENT

The expedition planned to concentrate its work in the northern third of Labrador, in part because it was least known, in part because of its greater interest from the standpoints of physical geography and scenery. An additional incentive for the charting of the northernmost coast was pointed out by Sir Wilfred Grenfell. Steamers operating on the new route from Port Churchill to England should have available a harbor of refuge in the vicinity of Hudson Strait. The great tides in Ungava Bay render the west side of Cape Chidley

FIG. 4—The eastern entrance to Grenfell Tickle may be seen on the extreme right. A "tickle" is a passage running right through to another water body. August 3, 1931.

unsuitable for such a purpose; whereas the coast southeast of the cape, with its moderate tides, offers a number of possible havens.

As Nachvak Fiord, in the southern half of the Torngat range, had already been studied by three scientific expeditions (Brown-Harvard, 1900; Coleman, 1915; Iselin, 1926) and more carefully mapped than any other part of the mountain region, we took this as the southern limit of our survey and planned to devote ourselves to the region between there and Cape Chidley. This, we estimated, was as large an area as we could hope to cover in a single season.

It has long been known that the Torngat Mountains present extremely interesting problems to the glaciologist and the student of plant geography,[1] and a geologist and a botanist were included in the expedition. In developing our plan of campaign we were led to look on the region just south of Ryan's Bay as an objective of

[1] M. L. Fernald: Persistence of Plants in Unglaciated Areas of Boreal America, *Memoirs Gray Herbarium of Harvard Univ.*/ No. 2, Cambridge, 1925, pp. 316–317.

FIG. 5—Looking northwest into Ungava Bay near the northern end of the Ungava Peninsula. Port Burwell is at the head of the small bay that lies two and one sixteenth inches from the bottom and one and a quarter inches from the left margin of the photograph. August 3, 1931.

especial interest. Here is a group of mountains known as the "Four Peaks." Their altitude had been estimated by Woodworth and others as about 7000 feet, which would make them the highest land in eastern North America.[2] Just south of these peaks, in the vicinity of "Seven Islands Bay," is Mt. Tetragona, described by Coleman and visited by E. S. Bryant and H. S. Forbes in 1908. Bryant made

[2] Robert H. Woodworth: Notes on the Torngat Region of Northern Labrador, *Geogr. Rev.*, Vol. 17, 1927, pp. 632–642.

FIG. 6—Port Burwell, a Hudson's Bay Company post on the western side of the tip of the Ungava Peninsula. August 3, 1931.

a careful examination of a glacier on the northern slope of this mountain and obtained excellent photographs showing it in detail. His observations were unpublished, but he generously furnished us with prints of his pictures. To reëxamine this glacier after a lapse of 23 years and obtain photographs for comparison with Bryant's became a specific objective.

The first essential in equipment was the boat. A sturdy schooner, 97 feet long over all, built in Nova Scotia for Dr. Columbus Iselin for oceanographic work, was obtained. The *Ramah*, as we renamed

her, was equipped with a Murray and Tregurtha 110 horse power engine, fitted with a shore nebulizer, which enabled it to operate on a safe fuel oil. Thus we had a motor powerful enough and compact enough to meet our needs and at the same time avoided the fire hazard of a gasoline engine.

In the spring of 1930, when our plans were taking definite shape, Sir Wilfred had suggested that an airplane would be of great advantage to the survey. To this end we obtained a Fairchild cabin monoplane and hired a Fairchild surveying camera. Then, because of the added safety of flying in pairs when far from civilization and also to render possible reconnaissance flights when the weather was good without interfering with the all-important aerial photography, it seemed highly desirable to have a second plane. For this purpose one of the party put his Waco biplane at the service of the expedition. The Waco proved very valuable, for, being much smaller and lighter than the Fairchild, it could travel twice as far to the gallon of gasoline.[3] Both planes were equipped with pontoons. For our base we had the advice of Sir Wilfred Grenfell and Dr. Iselin, both of whom recommended Ryan's Bay as a suitable anchorage for seaplanes.

Now came the problem of the method of survey. Two main procedures are in general use for aerial reconnaissance mapping. The first is to take an overlapping series of pictures with the camera pointed vertically down at the ground; the pictures are fitted together, and in this way a mosaic is made. The method is costly both of film and flying time. The second method, used extensively in Canada, is to take oblique pictures, each of which covers a large area extending away to the horizon; perspective grids are drawn on the photographs and the features are redrawn on a rectangular grid. Both these methods serve well for flat country but are not applicable to a mountainous region such as the Torngats.

It was a timely coincidence that Mr. O. M. Miller of the American Geographical Society had just developed a method, which he designated "planetabling from the air," for solving such a problem as that which confronted us.[4] The great advantage in the method lies in the fact that by it a contoured map of a relatively large area can be produced at relatively low cost. We were fortunate in obtaining the collaboration of the American Geographical Society, which sponsored the project and placed Mr. Miller's services at the disposal of the

[3] A liberal supply of aviation gasoline was given by the McColl Frontenac Oil Company of Montreal, and lubricating oil was given by the Wakefield Company. These supplies and fuel oil for the *Ramah* were sent in advance to St. Anthony, Cartwright, and Hopedale, the Newfoundland Government furnishing free transportation for the benefit of the survey.

[4] O. M. Miller: Planetabling from the Air: An Approximate Method of Plotting from Oblique Aerial Photographs, *Geogr. Rev.*, Vol. 21, pp. 201–212; and Additional Notes on "Planetabling from the Air," *Geogr. Rev.*, Vol. 21, pp. 660–662.

An application of the method is illustrated in the map of the Queen Maud Mountains (1 : 500,000) accompanying the article by Laurence M. Gould: Some Geographical Results of the Byrd Antarctic Expedition, *Geogr. Rev.*, Vol. 21, 1931, pp. 177–200.

expedition. The project forthwith took on a new interest, since it became not merely one of mapping a given area but an opportunity to demonstrate for the first time the efficacy of the new method in a survey planned and carried out in accordance with its principles. And here it should be stated that several months of work in the drafting rooms of the American Geographical Society will be required to produce the map. This and other results of the expedition will be published in due course.

The Journey to Indian Harbor[5]

On June 16 the *Ramah* got under way from Boston for St. Anthony, our rendezvous with the Fairchild plane. We left St. Anthony about noon on July 2 and dropped anchor in Indian Harbor on July 6 shortly before midnight. Here we were hospitably received by the staff of the Grenfell Hospital. The Fairchild plane had arrived eight hours earlier. The following day was clear and tranquil, perfect for a reconnaissance flight to decide on our further course. If the sea was clear of pack ice off shore, it would be a simple matter to put to sea from Cape Harrison, sail north well outside all the islands and reefs, and make our landfall at Cape Mugford, bold, easily recognized, and free of outlying shoals. If the outside passage was blocked by pack ice, we were advised to work our way north inside the islands.

The best possible way to ascertain the ice conditions was from an airplane. Therefore, after lunch, Crowley took off in the Fairchild plane with Miller and myself as passengers. We flew north to Cape Strawberry, about eighty miles away to the northwest. Three objectives were attained in the flight of less than two hours. We observed the sea to be free of pack ice for at least sixty miles north of Cape Mokkovik. With a Leica camera we obtained 41 photographs revealing the details of the shore line for many miles, especially in the region of Byron Bay, where the existing charts show only a dotted line. Here we observed an inlet extending westward some eight or ten miles, of which there is no indication on the chart. Finally we were able to assure ourselves that as far as Cape Mokkovik the route indicated on the chart and in the coast pilot was free of shoals except where the rocks were awash and clearly visible. At this point the fuel problem led us to change our original plan of sailing north outside of the islands. We had ordered a large supply of fuel oil sent to Hebron. But the only means of getting the oil delivered was the

[5] The crew of the *Ramah* consisted of A. Forbes, skipper; F. T. Hogg, mate; O. M. Miller, geographer; N. E. Odell, geologist; E. Abbe, botanist; E. Brooks, Jr., radio operator; Dr. H. E. Kennard, surgeon; D. J. Smith, engineer; C. Hatcher, cook; J. L. Madden, B. Morris, R. S. Hurlbut, and W. T. Grenfell, Jr., assistant surveyors and crew. The aerial section consisted of S. O. Bonnick, photographer; H. G. Crowley, pilot of the Fairchild plane; J. K. Brownell, pilot of the Waco; C. J. Hubbard, co-pilot. Three ladies also were included in the ship's company, the wives of the mate and the geologist and the skipper's daughter.

FIG. 7—Looking southwest across the northern range of the Torngat Mountains. August 3, 1931.

FIG. 8—Northern end of the central range of the Torngat Mountains looking northwest to the shore of Ungava Bay in the background. Cirque cutting has notched the border of an older erosion surface that fills the left foreground. August 3, 1931.

FIG. 9—Looking southeast down the axis of the central range of the Torngat Mountains. The low drainage basin on the left leads down to the region of Komaktorvik Fiord. August 3, 1931.

FIG. 10—Looking southeast from the central range of the Torngat Mountains. Nachvak Fiord can be seen in the middle distance. The horizontal clouds in the background lie over the sea. August 3, 1931.

ground. Cirque cutting has notched the border of an older erosion surface that fills the left foreground. August 3, 1931.

Hudson's Bay boat, and grave doubts were expressed as to whether she would have room for it. We therefore decided to put in at Hopedale where we could be sure of fuel.

A study of the Coast Pilot indicated that the chart would guide us to within about ten miles of that important harbor; but then for four or five miles was a labyrinth of islets north of Kayaksuatilik, where confusion and shoals were rife. Still we possessed a means of avoiding shoals without the aid of a local pilot. Professor F. P. Magoun kindly put at our disposal the patent specifications of his father's towing device, or submarine kite, which can be towed steadily at any desired depth below the surface. Two of these can be adjusted to drag a wire stretched between them and when sent ahead in tow of the motor tender will sweep a safe channel for the schooner.

Indian Harbor to Hebron

Just as we were preparing to weigh anchor on the morning of July 8 the Waco plane arrived, piloted by L. M. Lombard and accompanied by A. H. Bright in a Moth in which these two returned to Boston, Brownell flying the Waco hereafter. In the afternoon we again prepared to depart. It was known that the charts were unreliable north of Indian Harbor, but we had not expected to find the limit of reliability running through the middle of the harbor. Starting out through the northeastern passage where the detailed harbor chart shows a row of soundings of 2¼ to 2¾ fathoms, we were surprised to fetch up on a ledge with only 8 feet at low tide. This delayed our departure till the next day. At the entrance to Flagstaff Tickle north of Kayaksuatilik we put over the tender and, with the wire drag towing at a depth of 20 feet, followed her through a maze of islands till the way was clear to Hopedale. Here we found both planes.

On July 13 Commander MacMillan arrived in his motor boat. He planned to return to Nain next day and kindly volunteered to show us the way through the islands to that point and on to Port Manvers, where we should again reach the open sea. Next day, July 14, a 25-minute reconnaissance flight was made in the Waco plane over the Kayaksuatilik group of islands. The shoals were located, and 23 pictures were taken with a Leica camera showing the disposition of islands in this complex labyrinth.

At one o'clock we started north with Commander MacMillan on board and his motor boat following astern. For a day and a half we threaded an intricate maze of beautiful islands, those farthest from the open sea being well timbered. From Nain to Port Manvers Wheeler's map published in the *Geographical Review* for July, 1930,[6]

[6] E. P. Wheeler, 2nd: Reconnaissance Map of the Labrador Coast in the Vicinity of Nain (scale 1:500,000), accompanying Journeys about Nain: Winter Hunting with the Labrador Eskimo, *Geog. Rev.*, Vol. 20, 1930, pp. 454–468.

FIG. 10—Looking southeast from the central range of the Torngat Mountains. Nachvak Fiord can be seen in the middle distance. The horizontal clouds in the background lie over the sea. August 3, 1931.

FIG. 11—Looking southward across the southern end of the central range of the Torngat Mountains. The photograph shows the abundance of small glaciers. The expedition was in the field in early August when only permanent snow lay in the steep-walled cirques. August 3, 1931.

was found surprisingly accurate, much more so than any of the charts. Careful notes were taken of all landmarks and of courses and distances between them.

July 16 was another clear day. Our course took us well outside the islands to Mugford Tickle, where we anchored at sunset in a beautiful cove under the crags of the Kaumajet Mountains, a mile west of the southwest entrance of the tickle. Here, at Geology Cove, as we called it, Odell, Abbe, and Kennard had a day on shore geologiz-

FIG. 12—Looking west up Kangalaksiorvik Fiord showing the *Ramah* at anchor in Seaplane Cove. Taken during reconnaissance flight in Waco plane. In the left foreground, margining the curve of the shore, is the snow bank on the shore of "Shoal Cove," whereby we identified our position in the fog. July 26, 1931.

ing and botanizing. Next day we reached Hebron. Both planes were already there, and on the previous day Brownell and Miller had made an important reconnaissance flight north to Seven Islands Bay, where they found on the south side of its northern branch, Kangalaksiorvik Fiord, a perfect anchorage for the *Ramah* and the planes in a sheltered cove with enough low land along its shores to render the approach for the planes easy under all conditions. Miller had taken a number of Leica pictures showing the lay of the land at the entrance to the fiord, and these were developed promptly to serve as an aid in finding the desired base. He also observed that the entrance to the fiord south of Big White Bearskin Island appeared to be clear of dangerous shoals. We were now close to the southern border of the Torngat Mountains and wished to have a look at the country surrounding Hebron Fiord. The Fairchild plane was made ready, and between courses at supper Crowley, Odell, Brownell, and I went up for a 50-minute flight which covered the entire extent of the fiord and

revealed five rivers emptying into it, none of which are indicated on the chart. Thirty Leica pictures were taken, which will suffice for a fair sketch map of the fiord.

Hebron to the Base Camp

Two days of sailing with a stop for the night in Ramah Bay brought us to Rowsell Harbor, which we entered in a fog. On July 21

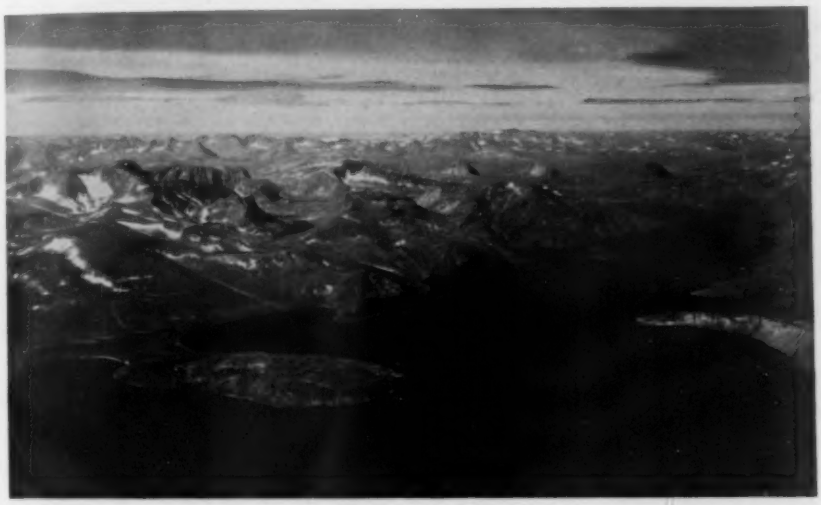


Fig. 13—Kangalaksiorvik Fiord, showing Amiktok Island in the right foreground and, on the left, Shoal Cove and Seaplane Cove with the headland Nehungateluk between them. Tetragona is the large mountain in the left middle distance with a conspicuous glacier on its nearer face. August 3, 1931.

we set out for the last lap of the journey to our proposed base in Kangalaksiorvik Fiord, a 40-mile run. Again dense fog was encountered at the mouth of the harbor. We were eager to reach our base as soon as possible, and the direct course was from Gulch Cape to Cape White Handkerchief. The position of Cape White Handkerchief, however, was quite uncertain. On Grenfell's map it is about three miles southeast of the position given on the Admiralty chart, and the shore line north of this cape was entirely different on the two charts. Without more information than this, we should not have attempted to find our base in the fog, but the photographs obtained by Miller on the reconnaissance flight on July 17 enabled him to make a very fair sketch map showing the disposition of headlands and islands at the entrance to Kangalaksiorvik. Counting on this we took our departure from Gulch Cape. When by both the Grenfell map and the Admiralty chart we should have been high and dry on Cape White Handkerchief, we were still heading northwest with no land in sight. It became evident that either because of a tidal

FIG. 14—Ryan's Bay (center); Kangardluarsuk, beyond its left-hand shore, is shown to be a short cove with no drainage. Looking east. August 3, 1931.

current or because the cape was farther west than shown on either map, we had rounded it without seeing it and were now crossing Sapogatsiek Bay. When we were due to reach the west shore of this bay we sighted land about four hundred yards ahead. Turning sharply to starboard we followed the shore line till, curving round to the west, it ended in a point. This convinced us that our landfall had been made on Big White Bearskin Island. Acting on this hypothesis we proceeded west and picked up the shore of Seven Islands Bay. Keeping this close aboard, we followed it to the entrance of Komaktorvik Fiord. Crossing this we again lost the shore in the fog but soon picked it up on the other side and followed it into the shoal water of the cove next before that which Miller and Brownell had selected as our base. This cove was positively identified in the photographs by means of a long snow bank just above the water's edge, which showed distinctly in the negative (cf. Fig. 12). At five o'clock we came to the exact spot where Brownell and Miller had landed in the Waco plane after choosing

FIG. 15—The braided channels in the central foreground constitute the Komaktorvik River, which flows down to the head of Kamaktorvik Fiord. The lower course of the river and the head of the bay show typical postglacial alluviation. August 3, 1931.

it as the most favorable base for our operations. Here we lay at anchor for 19 days.

The weather continued foggy until July 24, but preparations for the main work of the expedition went forward. The tide gauge was unpacked and assembled and set up on a steep rocky point on the east side of the cove. The shores of the cove were explored, a fine mountain brook was found for a watering place, and a level bit of ground beside it was chosen as the site for a photographic dark room. On July 24, the day on which the planes arrived, the surveyors had already begun their reconnaissance in preparation for triangulation. A word should be said here about the method.

METHOD OF SURVEY

The method employs oblique aerial photography. With a knowledge of the focal length of a camera, its position at the moment of

exposure can be accurately determined by trigonometrical methods provided the images of three points whose true positions are already known can be identified on the photograph. When the positions of the airplane at the taking of two such pictures have been found, the position and height of any unknown point whose image appears on both photographs can be determined by intersection. If the true positions of a number of conspicuous points, such as mountain peaks and headlands, have been determined by triangulation from the ground, it is possible with this method to determine the positions of as many other points appearing in the photographs as are desired. These points can then be used as known points in other photographs, and in this way more remote points inaccessible to the ground control can in turn be fixed. When a sufficient number of points have been fixed the topography is sketched in as in plane-table work.

The area to be mapped was covered with photographs taken in all directions from altitudes ranging from 4000 to 9000 feet with the camera tilted so that the apparent horizon or sky line appeared about a quarter of the way down from the top of the photographs. The ground control in this survey consisted of two local triangulations containing each a measured base. They were about forty miles apart. From each of these triangulations prominent points in the landscape were intersected. A few of these points were fixed from both triangulations, and thus both networks were joined into one connected whole. In addition each triangulation contained an astronomical station for latitude, longitude, and azimuth; and the whole system was connected trigonometrically to the automatic tide gauge, which enabled a sufficiently precise determination of mean sea level to be made. Additional stations well apart from the main triangulation net were also occupied, and their positions were determined by rounds of angles to points already intersected. Other prominent points not visible from the triangulation systems were then intersected from these resected stations.

The work of the survey was begun in earnest on July 25. Three main stations on neighboring heights at elevations from 500 to 2000 feet were selected and marked with white flags on iron posts set in cement. The size, position, and orientation of this initial triangle were later determined by a base line on the flat country between Seaplane Cove, as we named our base, and Komaktorvik Fiord, and by an astronomically fixed station on the shore by the tide gauge.

Hubbard and Bonnick started fitting up a dark room with shelves, running water from the brook, and a cement-lined trough for washing the film. They also built a large drying rack outside the dark room, protected by a canvas awning and cloth mosquito netting. The water of the brook was much too cold for the developing and fixing solutions, and a coal stove was improvised from an empty oil drum.

The morning of July 25 Odell and I made a ninety-minute reconnaissance flight in the Waco plane. We flew up Kangalaksiorvik Fiord and obtained a photograph of Bryant's Glacier (see Fig. 22). Thence we flew south over a flat country with some good-sized lakes, which would have served for landing in case of need, till we reached the head of Nachvak Fiord, over the entire length of this to the sea, and back along the shore. This flight gave us an excellent view of about half the entire Torngat Range. We selected a lake on the stream emptying into Komaktorvik Fiord as a base for the geological party, and two of the men comprising it, and equipment were flown in before nightfall.

Flights for the Survey

On the afternoon of the 26th, for the first time, the sky was clear enough of clouds for the taking of topographical pictures from the air. In a flight of an hour and three quarters Bonnick took 40 photographs, covering the shore line from Nachvak to Eclipse Harbor.

From the 27th to the 30th another spell of low clouds and fog caused the suspension of the chief activities, but there was plenty to do developing film and calculating the results of the triangulations already made. We also obtained a good many soundings from a dory with lead line and depth gauge, fixing their positions with a Paget angle sextant.

On July 31 the weather improved, though clouds still hung close over the tops of most of the higher peaks to an extent that prevented the taking of satisfactory topographical photographs, and the Fairchild plane did not go up. A reconnaissance flight in the Waco to Ryan's Bay, 12 miles north, showed the route to be clear of shoals a mile off shore all the way up. It also yielded a number of very fine Leica photographs of the islands and of the mountains in the Four Peaks Region. And it served to deepen the mystery concerning the map designated Kangardluarsuk Inlet published by Gould in the *Geographical Review* for January, 1928.[7] As we flew over the mouth of Ryan's Bay, Kangardluarsuk Fiord was clearly visible close to the north of it. It proved to be no more than a deep cove with steep cliffs on the right and separated from Ryan's Bay at its head only by a narrow strip of low land. No visible stream entered it, whereas a river draining a chain of lakes figured in Gould's map. The solution of this puzzle appeared when we examined other photographs of the region. Obviously the inlet mapped by Gould was Eclipse Harbor. The first lake was the arm of the sea extending around the west side of Aulazevik Island, and the canyon and the second lake could be

[7] Laurence M. Gould: Report on the Physical Geography (The Putnam Baffin Island Expedition), *Geogr. Rev.*, Vol. 18, 1928, pp. 27–40; map on p. 27.

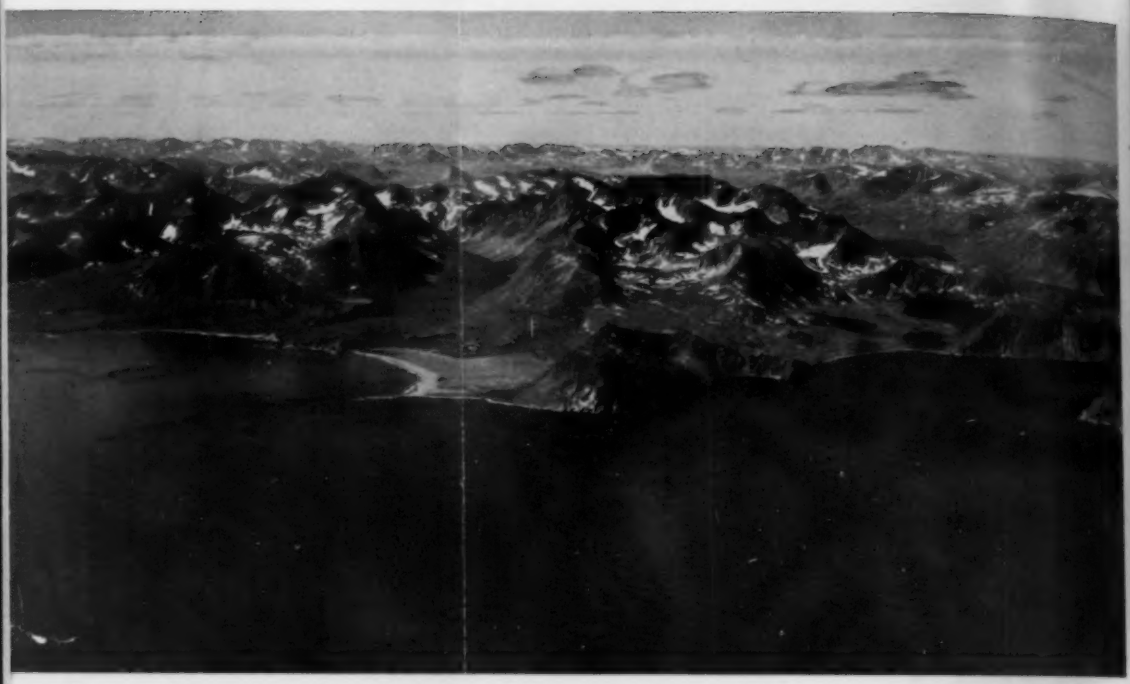


FIG. 16—Wide panoramic view of the bold glacially eroded coastal massif known as the "Four Peaks." The crest of the central range of the Torngat Mountains is on the horizon. The shore on the left is the northern end of the Iron Strand. August 3, 1931.

FIG. 17—Seven Islands Bay from the northeast. Nehungateluk in center and mouths of Kangalaksiorvik and Komaktorvik to right and left respectively. Avigalik (Whale Island) in the foreground, Amiktok between this and Nehungateluk. August 3, 1931.

FIG. 18—Looking southwest across the mouth of Kangalaksiorvik Fiord. August 3, 1931.

FIG. 19—Razorback Harbor in the center of the picture, Razorback Mountain between it and the mouth of Nachvak Fiord to the left. August 2, 1931.

clearly seen in the photographs. It was a striking demonstration of the enormous advantage of aerial observation and photography in clarifying an obscure and confusing region.

On August 1 a westerly gale blew all day. In the afternoon Brownell made a reconnaissance flight in the Waco plane up Kangalaksiorvik Fiord and over the country between the head of it and the head of Ryan's Bay and obtained some excellent Leica photographs. In the evening the sky was clear enough to enable Miller to fix the geographical position of a station on the shore with theodolite observations of six stars. The next day the sky was very clear, and the Fairchild plane went up on another photographic flight. In 2 hours and 40 minutes the coast all the way from Nachvak to Cape Chidley was photographed.

August 3 was the greatest day of the entire expedition. From morning till night the sky was almost cloudless and very clear. The gale had moderated to a fresh breeze, which died altogether during the day. The Fairchild plane went up and flew for three hours in the morning. Nearly 200 pictures were taken, comprising views looking westward from five miles out to sea from Kangalaksiorvik to the Button Islands and another series taken while returning southward over the center of the peninsula. In the afternoon a second flight was made, following the shore south to Nachvak, then crossing the peninsula to the mouth of the George River at 9000 feet, then, from a point five miles off shore over Ungava Bay, flying north and photographing eastward all the way to the Button Islands. A landing was made at Port Burwell where permission was obtained to use some of the supply of aviation gasoline which had been left by a previous expedition, in case of need. The flight ended at eight o'clock, the plane having been in the air seven hours during the day and having secured a total of about 330 pictures.

Miller, having completed his triangulations in the vicinity of Seaplane Cove, went with Hubbard in the Waco plane, flown by Brownell, to the base camp on the lake, vacated by the geological party the day before. They camped there and then proceeded to extend the triangulation inland from occupied stations on mountain peaks near the camp. From there they walked north, carrying the remaining camp gear on their backs, to the head of Kangalaksiorvik Fiord, where they were met by the motor tender on August 5.

On August 4 the morning was auspicious, and an expedition consisting of Odell, Abbe, Brooks, and myself set out to climb one of the larger peaks on the north side of Kangalaksiorvik Fiord. During the day the clouds shut down over the mountains and blotted out the view, but in spite of this Odell and I went to the top of the mountain, a most interesting climb. In the morning, before the clouds shut in, the Fairchild plane went up 10,000 feet to obtain a mosaic of vertical

FIG. 20

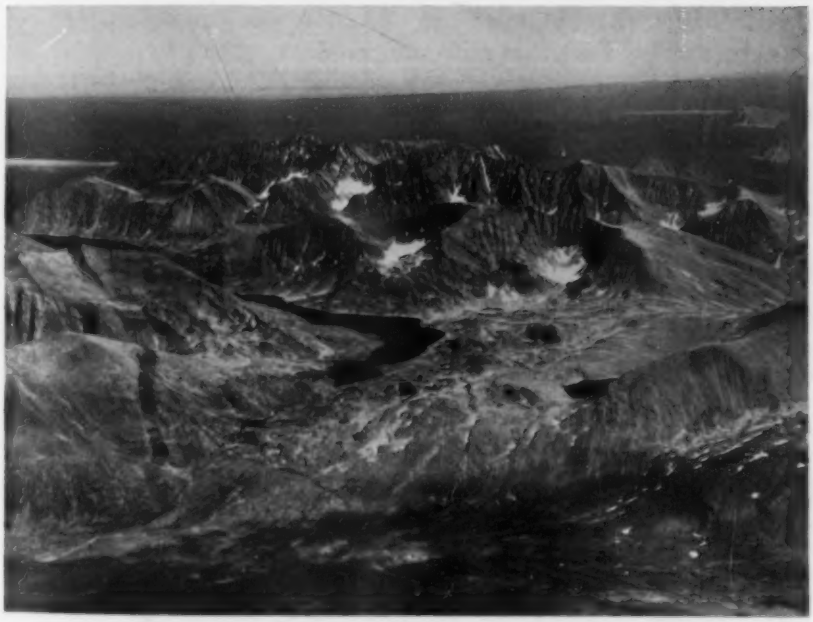


FIG. 21

FIG. 20—The "Four Peaks" group of deeply glaciated alpine forms at the head of Ryan's Bay, which may be seen at the left center. August 3, 1931.

FIG. 21—Razorback Mountain, looking east. One of the fiorded and glacially eroded massifs rising steeply from the coast of northern Labrador. July 26, 1931.

photographs of the mouth of Kangalaksiorvik Fiord, covering the area in which soundings had been made. This will furnish a more detailed and accurate map of the shore line in this district than would be possible from the oblique pictures alone.

Bad weather now held for six successive days. On August 5 we received word by radio that neither fuel oil for the *Ramah* nor gasoline for the planes could be delivered at Hebron; hence economy was indicated. Virtually the entire peninsula north of Nachvak across to Ungava Bay had been covered by our photographs; but a few small gaps remained, and supplementary views in certain directions from a lower altitude were needed as additional control. After close study Miller with Crowley and Bonnick figured a route whereby in a two-hour flight between Nachvak and Ekortiarsuk, flying between 5000 and 3000 feet high, all the remaining pictures that were needed could be taken and a safe margin of fuel left for the return to Hopedale. On the next clear day this was to be done, and as soon as the films were developed the planes were to proceed southward. We waited at our base for better weather while Bonnick developed the pictures already taken, and Odell, on August 8, made an excursion to Bryant's Glacier, where he took photographs from the same point of view as Bryant's pictures 23 years earlier.

Preparations were made for the aerial party to camp beside the dark room while the *Ramah* went north to extend the triangulation to Ekortiarsuk and Cape Chidley. A lean-to was made of a spare gaff-topsail and the remaining lumber. The improvised coal stove was set up inside, and a table and bench were constructed.

The "Ramah" Sails Northward

On August 9 the clouds had risen a little from the water, though they still hung heavily over the mountains. At 11.30 a. m. we weighed anchor and set out for Ekortiarsuk, but, beating against a stiff north wind, it took all the afternoon to get by the Iron Strand. At 6 o'clock we reached the majestic entrance to Ryan's Bay and put in there for the night. Two miles up the fiord, by the anchorage recommended in the Coast Pilot, were two white tents, the first human habitations since we left Hebron. We had not been at anchor long before two Eskimos in their kayaks came out and visited us. They could speak no English, nor could we speak Eskimo, but we showed them several prints which Bonnick had made from the aerial photographs taken in this vicinity. The Eskimos do not fly, nor do they climb mountains, as a rule. We wondered whether the aerial pictures would mean anything to them. To our gratification they studied the photographs with great interest and readily recognized and identified a number of points along the coast. They gave us the following names, which Miller took down

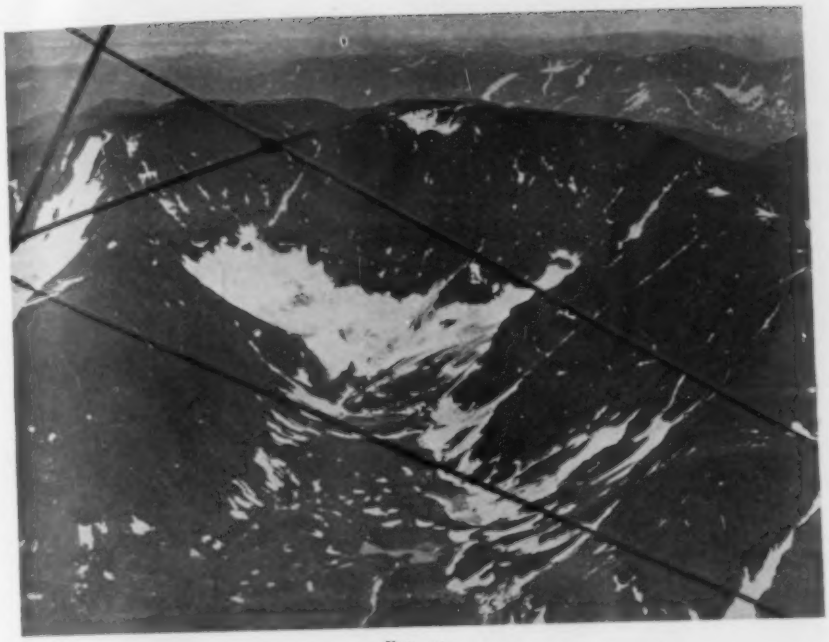


FIG. 22

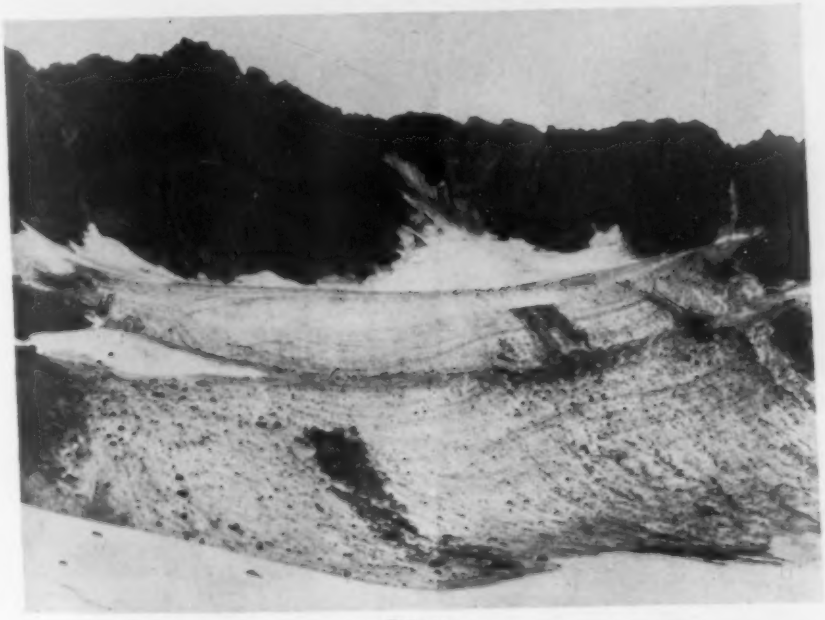


FIG. 23

FIG. 22—Bryant's Glacier on the north side of Mt. Tetragona. Photograph by Odell on reconnaissance flight. July 25, 1931.

FIG. 23—Glacier on the north face of Razorback Mountain. The photograph was taken from a height of about 1000 feet above sea level: the summits of the ridge are about 3500 feet above sea level; the length of the glacier is estimated at between one-third and one-half of a mile. . . . August 17, 1931.

FIG. 24—The central range of the Torngat Mountains is cut through approximately east and west by deep troughs with irregular, rocky, lake-dotted floors of which the above is a typical example. Looking west. August 11, 1931.

phonetically as best he could: Nehungateluk, the headland east of Seaplane Cove, which we had provisionally named "Tide Gauge Head"; Amiktok, the island between Nehungateluk and Whale Island; Kunglia-uk, Ryan's Bay, where we were now anchored; Pemeluagh, the headland of the northern side of the entrance to Ryan's Bay.

Next day the weather in the morning was still disagreeable with low clouds. In the afternoon we went ashore and visited the Eskimo camp. In the two tents were living eleven Eskimos, men, women, and children, including small babies. Miller took his theodolite up on the mountain north of the anchorage, but clouds prevented him from getting the angles he wanted. The next day, however, proved

FIG. 25—Lakes above Komaktorvik Fiord, in the central range. The base camp of the geological party was on the right-hand side of the nearer lake in the cloud shadow. Precipice Peak rises behind the camp. Looking southwest. August 11, 1931.

clear and fine; and Miller with Morris and Brooks climbed the mountain and, by taking angles on several peaks that had been intersected from farther south, extended the triangulation well to the northward. They made such quick work of this task that we were able to sail before noon.

Outside Ryan's Bay a west wind helped us on our way north, and the air was so clear that we could see Cape White Handkerchief to the south and Cape Chidley to the north. From the south end of Aulazevik Island northward numberless reefs dot the surface of the sea and extend for miles off shore; but, following Grenfell's instructions and maintaining a constant masthead lookout, we found a deep

FIG. 26—Looking southwest across the "Four Peaks" group of mountains which fill the foreground and middle distance. August 2, 1931.

FIG. 26—Looking southwest across the "Four Peaks" group of mountains which fill the foreground and middle distance. August 2, 1931.

FIG. 27—Similar view to Figure 26 but looking more directly westward. These two pictures illustrate the possibilities of intersection on oblique photographs taken from two different air stations. August 2, 1931.

water passage along the shore past the mouth of Eclipse Harbor and Cape Kakkiviak, and nowhere on this stretch of the coast did we find evidence of shoals or submerged reefs that could not be clearly seen from the deck. Rounding Black Rock Point we followed the course indicated on the sketch map given us by Iselin, supplemented by Bonnick's photographs, to the mouth of Ekortiarsuk Fiord. Our aerial photographs of the fiord enabled us to select an anchorage in its eastern arm, where the lay of the land suggested reasonably shallow water. When we rounded Black Rock Point there were still many hours of daylight, and the clear weather was too good to waste. Miller and Kennard went ashore at the base of the high land on Cape Kakkiviak, climbed to the height of the cape, established a station, and began the northern triangulation, while we continued our way through the islands into the fiord.

The eastern arm of the fiord, which we believe to have been hitherto unexplored, proved to be an excellent anchorage. Excepting a steep cliff at the entrance, the shores are gently sloping, which renders the fiord comparatively free from violent squalls. The depth in the middle is 7 fathoms, from which the bottom slopes gradually to the shore.

On August 12 a heavy gale blew all day, but the air was very clear. Miller, Madden, Morris, and Grenfell established two more stations, from which many peaks to the south were intersected, some of which, being included in the southern triangulation, served to tie the two nets together. The evening was clear, and Miller obtained a good astronomical fix by star sights, thus controlling the northern triangulation with a check independent of the work farther south. Next morning, while Miller took a sun azimuth from the shore, an improvised tide gauge was set up.

August 14 was a perfect day. Odell, Abbe, Morris, and Hurlbut crossed the fiord to the west side and explored the highest mountain ridge in the region, extending from the west arm of the fiord out to sea. Miller and Madden completed the triangulation and tied it in firmly with the triangulation farther south by means of angles taken on Gulch Cape, Big White Bearskin Island, Cape White Handkerchief, and other points. That afternoon at half past four, our work virtually completed, we started out of the fiord and anchored for the night at Iselin's anchorage in the cove just outside the entrance.

The next day, August 15, we started south and, rounding Cape Kakkiviak, met the Grenfell Hospital Ship *Strathcona* coming north to meet us. There was great rejoicing on both boats. Sir Wilfred Grenfell came aboard the *Ramah*, and we compared notes on all that had happened since we parted at St. Anthony. The *Strathcona* was carrying several barrels of fuel oil for the *Ramah* and gasoline for the planes, and she had been searching for us in all the fiords

from Nachvak north. She turned south and accompanied us to Kangalaksiorvik Fiord, where early in the afternoon we anchored side by side in Seaplane Cove. The planes had already gone south.

On August 16 we left our familiar base for good. Razorback Mountain was our next objective. Our aerial photographs indicated a good anchorage under its northern slope in a deep indentation between it and Cape White Handkerchief. So far as we could learn this has not been used previously as an anchorage, but from the photographs it appeared to be free from dangerous shoals. We reached the mouth of the harbor in the twilight. A bar with 6 fathoms of water extends more than halfway across the entrance, and this helps to keep the ground swell from rolling in to the head of the harbor. Proceeding slowly under power and sounding frequently, we found an excellent anchorage close to the head of this small fiord, which we called Razorback Harbor. The next day Odell and Morris climbed to the top of Razorback and followed the ridge westward to the shores of Nachvak Bay. At the same time Miller, Madden, and Abbe climbed up the ridge on the north side of the harbor to extend the triangulation southward. This done we sailed for Nachvak, finding a deep channel between the somewhat numerous reefs off the shore east of Mt. Razorback and picking up Odell and Morris at Skynner's Cove.

On August 18 we made an excursion up Nachvak Fiord for a brief geological survey on the north shore near the abandoned Hudson's Bay Post and thence proceeded to Rowsell Harbor. On the following day we rejoined the *Strathcona* and on the 20th proceeded in company with her to Mugford Tickle. Here we lay at anchor all day on the 21st while Odell, Abbe, and Morris explored the northern end of the Kaumajet Range, which they had been unable to reach when we stopped there on the way north. This time they climbed to the summits of both peaks of the Bishop's Mitre and another peak farther west.

On August 22, with our work in the mountains completed, we started south, passing through the same inland passage that Commander MacMillan had shown us on the way north. Fair winds enabled us to reach Hopedale with a few gallons of oil left in our tanks. There we replenished our supply; and, while waiting for the end of another mean, rainy, northeast gale, we learned from Mr. Perret the meanings of some of the Eskimo names of the places we had visited. Ekortiarsuk should be Ikordlearsuk, "where the reindeer swim across." Kangalaksiorvik means "place where one can hunt deer while they are changing their hair." Nehungateluk means "bridge of the nose"—appropriate for a headland between two rounded coves. From Hopedale we proceeded homeward, reaching Boston September 13. The planes, it may be added, went to Grand

Falls on their way south, and the Fairchild reached Boston September 12, while the Waco, delayed at St. Anthony by a disabled engine, returned October 6.

Results of the Survey

The main geographical result attained was the aerial survey of the Labrador peninsula north of Nachvak, comprising about 4000 square miles, reinforced as it was by the extensive triangulation of the ground control. More than 500 photographs, mostly obliques, were taken with the Fairchild camera. The total flying time required to obtain the topographical photographs for the survey was about 15 hours. These pictures are supplemented by over 700 photographs taken with a Leica camera, some from the Waco plane and others from the boat or from heights of land. The ground control included about 30 points accurately intersected from two or more occupied stations in one of the two main triangulation nets. Additional points, located by means of angles taken from secondary stations, made a total of over 100 points, from south of Nachvak Fiord to the Button Islands, fixed by triangulation. This will provide a skeleton whereby the material furnished by the photographs can be built into a dependable map of the whole area. About 200 soundings were recorded, nearly all of which can be accurately placed on the map.

Incidentally, photographs from the air were taken, with both the Leica and the Fairchild cameras, of portions of the coast farther south, including Hebron Fiord, Cape Mugford, the Kayaksuatilik group of islands east of Hopedale, and the greater part of the coast from Indian Harbor to Cape Mokkovik. From these, sketch maps can be made, which, in many cases, will give more accurate details than can be found on the existing charts. Sailing directions for a coastwise journey were noted, with the aid of aerial observation of shoals. With those already in the Coast Pilot, indications are adequate for a cruise from Battle Harbor to Ekortiarsuk. This material will be placed on file with the American Geographical Society for the use of any who are interested.

REPORT OF THE PRELIMINARY RESULTS OF THE AEROARCTIC EXPEDITION WITH "GRAF ZEPPELIN," 1931

Lincoln Ellsworth and Edward H. Smith

IT was a magical journey, this Arctic cruise of 8000 miles in 136 hours! In the kaleidoscope of swiftly moving scenes the high lights of our voyage seemed like flashes upon the screen, so quickly was one impression replaced by the next. The Franz Josef group covered in seven hours—Cape Flora at 5 p. m., Cape Fligely at midnight—six hours to Northern Land, another five hours to Cape Chelyuskin, and in two hours more Lake Taimyr below us! The old explorers who "did it on foot" must have given thought to the airway as they gazed from the encumbered ground to the freedom of the sky. Middendorff in 1843 spent a painful month on the journey from Lake Taimyr to the sea. Nansen sighted the northern shores of Franz Josef Land on July 24, 1895; it took him eleven months to reach Cape Flora!

The conception of the *Graf Zeppelin's* Arctic cruise of 1931 dates back to 1926 and the foundation of the Aeroarctic Society. In its first form the plan was for a crossing of the Arctic from the European to the American side under the leadership of Nansen.[1] The plan failed to mature, largely on account of the extremely high rates of insurance expected for a dirigible navigating so far north. Nansen's sudden death in 1930 brought a further postponement until the election of Dr. Hugo Eckener to the presidency of Aeroarctic later in the same year. Now in 1931 with a modified program the so-called preliminary flight has been successfully accomplished under the leadership of Dr. Eckener supported by a large scientific staff.[2]

---

[1] Nansen briefly outlined his plans in his address before the American Geographical Society on May 14, 1928; see *Geogr. Rev.*, Vol. 18, 1928, p. 495. For a note on Aeroarctic see *ibid.*, p. 512. For the plans for 1930 see "Die bevorstehenden ersten Erkundungs- und Forschungsfahrten der Aeroarctic im Frühjahr 1930 mit dem 'Graf Zeppelin,'" *Arktis*, Vol. 2, 1929, pp. 26–28.

[2] In addition to Dr. Eckener and Captain Walther Bruns, assistant to the leader and general secretary of Aeroarctic, and thirty odd members of the crew, the personnel included: Professor R. L. Samoilovich, senior scientist of the Arctic Institute, Leningrad, chairman of the investigating council for geographical studies, Aeroarctic, and leader of the scientific staff; Professor L. Weickmann, director of the Geophysical Institute, University of Leipzig, and chief of the meteorological investigations on the expedition; Professor P. A. Molchanov, director of the Aerological Observatory at Slutsk and co-worker on the meteorological investigations; Professor A. Carolus, of the University of Leipzig, assistant to the meteorologists; Dr. W. Basse, engineer, aerogeodicist, photographer for Carl Zeiss Co.; Dr. C. Aschenbrenner, engineer, aerogeodicist, photographer for Munich Surveying Co.; Dr. E. Kohl-Larsen, biologist and physician; Mr. Lincoln Ellsworth, civil engineer and representative of the American Geographical Society, Arctic expert for navigation; Lieutenant Commander Edward H. Smith, of the U. S. Coast Guard, representative of the International Ice Patrol, for ice and oceanographic observations; Dr. G. Ljungdahl, of the Swedish Hydrographic Office, in charge of earth magnetic observations.

Narrative of the Voyage

At 8.35 a. m.,[3] the morning of July 24, the monstrous bulk of the *Graf Zeppelin* began to move slowly out of its Friedrichshafen hangar; and a few minutes later we were headed northward towards Berlin, where a landing was made at 6 p. m. Early next morning we were off. Our course lay northward for Helsingfors, thence east for Leningrad, where we landed at 5.30 p. m. At 8.00 a. m., July 26, we were in the air again. In less than an hour out of Leningrad the country grew desolate, with few scattered settlements in marked contrast to the cultivated landscape to the south over which we had been flying. The country was a vast muskeg. At 4 p. m. we were over Archangel, the world's biggest lumberyard. Lumber hides the dwellings of the city of 10,000, and logs choke the waterways. From Archangel we headed northward. The Arctic Circle was crossed at 7 p. m. The wind, which had been light from the northeast all day, suddenly shifted to east-northeast and increased to a fresh breeze almost coincident with our reaching the Arctic Sea. The air temperature also dropped from 14° C. to 9° C., and it was quite apparent that we had left the warm atmosphere of Europe to enter much colder polar air. For a few hours we skirted the coast at altitudes from 200 to 500 meters. Much log wood lay scattered, in places very thickly, along the beaches. A few circular fish weirs, probably for salmon catching, were observed along these stretches of the coast.

Over the Barents Sea

Before we reached Cape Kanin at 10.53 p. m., the wind backed to north-northwest and freshened to a force of 5 or 6, Beaufort Scale. Our own course, now 6° true, for Cape Flora, Franz Josef Land, had to be corrected about 25° to the left in order to counteract this amount of wind drift to the right. To conserve fuel Dr. Eckener ordered two of the five motors stopped, and so the remainder of the night we bucked the wind towards Franz Josef Land at a speed of 37 miles an hour.

At 9 o'clock in the morning, latitude 74° 40′ N., a few drift logs were to be seen, and small birds skimmed the waves. The ship began passing through the first scattered patches of fog at an altitude of 200 meters. Then fog banks became more frequent and soon completely enveloped us. The air temperature of 4° C. had been more or less constant ever since we left Cape Kanin. In the latter part of the morning, however, as the dirigible progressed farther north, the thermometer dropped to 2° C., and the ship gradually emerged into clear atmosphere and bright sunshine. The blue sky overhead was in marked contrast to the white sea of fog over which we skimmed

[3] All time references are Greenwich Civil Time.

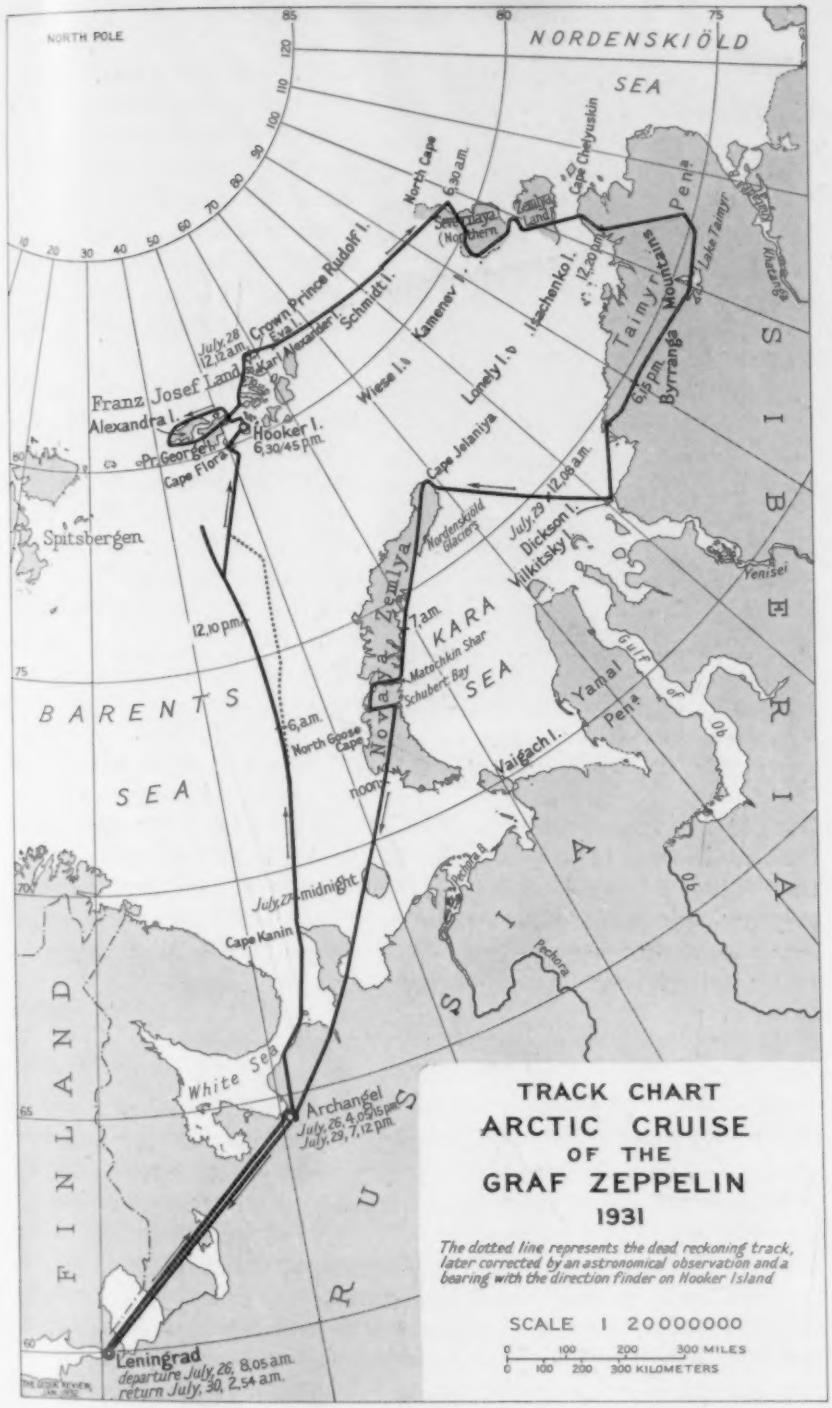

NORTH POLE
NORDENSKIÖLD SEA
SIBERIA
Franz Josef Land
Alexandra I.
Hooker I.
6,30/45 p.m.
Crown Prince Rudolf I.
Schmidt I.
North Cape
6,30 a.m.
Cape Chelyuskin
Taimyr Peninsula
Mountains
Lake Taimyr
Byrranga
6,15 p.m.
Kheta R.
Khatanga
Lenonly I.
Wrese I.
Kamenev I.
Jaschenko I.
12,20 p.m.
Cape Jelaniya
12,06 a.m.
July 29
Dickson I.
Vilkitsky I.
Yenisei
Spitsbergen
Nordenskiöld Glacier
Novaya Zemlya
Matochkin Shar
Schubert Bay
7 a.m.
KARA SEA
Yamal Peninsula
GULF OF OB
Vaigach I.
12,10 p.m.
6 a.m.
North Goose Cape
noon
July 27
midnight
Cape Kanin
BARENTS SEA
FINLAND
RUSSIA
White Sea
Archangel
July 26, 4,05 p.m.
July 29, 7,12 p.m.
Pechora
Leningrad
departure July 26, 8,05 a.m.
return July, 30, 2,54 a.m.
TRACK CHART
ARCTIC CRUISE
OF THE
GRAF ZEPPELIN
1931
The dotted line represents the dead reckoning track, later corrected by an astronomical observation and a bearing with the direction finder on Hooker Island
SCALE 1 20000000
0 100 200 300 MILES
0 100 200 300 KILOMETERS

FIG. 1

FIG. 2—Logs ready for the sawmill at Petrozavodsk on Lake Onega. (Photograph by W. Basse.)

at a height of 600 feet. About this time radio communication was established with the Russian ice breaker *Malygin*, 250 miles away at Hooker Island radio station, Franz Josef Land. She reported the first ice at 78° N. and also gentle northeast winds and foggy weather.

At 2.50 p. m., however, the stratus sheet beneath us was drawn aside, and far below, scattered here and there, lay the first of the sea ice, in long strips and strings, with much open water around. Then followed intermittent patches of fog, and finally at 3.30 p. m. we came out into clear air again and an unobstructed view of the horizon. The pack ice was composed of *glaçons* ranging in width from two or three feet to 75 and 100 feet. The ice appeared to be less than three feet in thickness; it was also quite flat, indicating a production sometime during the previous winter. As we proceeded farther north the polynyas and leads grew smaller and fewer. There was no such heavy ice as had been seen by Ellsworth on his flights of 1925 and 1926 fifty miles north of Spitsbergen.

FRANZ JOSEF LAND

During the afternoon the wind dropped to light airs, and the weather became beautiful. The southern islands of the Franz Josef Land group were sighted about 4.30 p. m., at a distance of thirty-five to forty miles. Black and forbidding, Cape Flora was ahead of us, a spot memorable in the annals of Arctic travel, for it was here that Nansen and Johanssen on their long trek from the *Fram* found succor from the Jackson-Harmsworth Expedition. Closer approach brought out more detail, but the main features remained predominant—bare basalt, table-topped headlands, outcropping here and there from the more general, overflowing glaciers. A belt of open water and scattered *glaçons* of sea ice surrounded Franz Josef Land on the south; and British Channel, except for an occasional ice cake, was perfectly navi-

gable for sea craft. This was an open season for Franz Josef Land, a condition that varies greatly from year to year.[4]

Flying up British Channel we soon could make out Hooker Island in the distance, and at 5.45 p. m. we were circling the radio and meteorological station located there on a raised rocky shelf. This lonely post established by the Russians in 1929[5] is the most northerly meteorological observatory in the world. The *Malygin*, anchored about a quarter of a mile off the shore, had been full dressed in honor of the dirigible's visit. The sea was now perfectly calm, and its surface, interrupted here and there by ice cakes, was like an upturned mirror. Conditions were ideal, and Dr. Eckener was ready to test a water landing on the air-inflated rubber pontoons, a method tried out at Friedrichshafen. Slowly and uniformly we began to descend. About 100 feet above the water a sea anchor was cast down and also several canvas dip buckets. The buckets, filled with water and drawn upwards a few feet, added just the right amount of extra weight to pull us down where we rode like a ship at anchor.

FIG. 3—Huge piles of sawn lumber ready for shipment at Archangel. (Photograph by Basse.)

A boat immediately put out from the *Malygin*. Post bags were hastily exchanged between the side door of the gondola and the bow of the *Malygin's* boat. In the stern stood Nobile, he having taken passage on the *Malygin* in the hope of finding some record of the ill-fated *Italia*. Ellsworth and Nobile exchanged brief greetings. A hurried take-off was made just as a large ice cake was swept dangerously close by the current. The Zeppelin now rose to an altitude of 1000 meters and heading westward flew across British Channel to the northeastern part of Prince George Island.

The automatically recording cameras were started from a known fixed departure point, the Hooker Island Radio Station. Hence the

[4] Notes on ice conditions are given in Gunnar Horn: Franz Josef Land; Natural History, Discovery, Exploration, and Hunting, *Skrifter om Svalbard og Ishavet No. 29*, Oslo, 1930.

[5] W. Wiese: Die Expedition des Eisbrechers "Sedow" nach Franz-Josefs-Land zwecks Aufbau einer meteorologischen Radiostation, *Arktis*, Vol. 2, 1929, pp. 126–128.

course skirted along the northern coast of Armitage Island and Alexandra Island. Inaccuracies in the map were immediately apparent; Armitage Island, for example, should be charted as a peninsula of Prince George Island; Albert Edward and Harmsworth Islands, recorded on existing maps[6] about fifteen miles north of Prince George

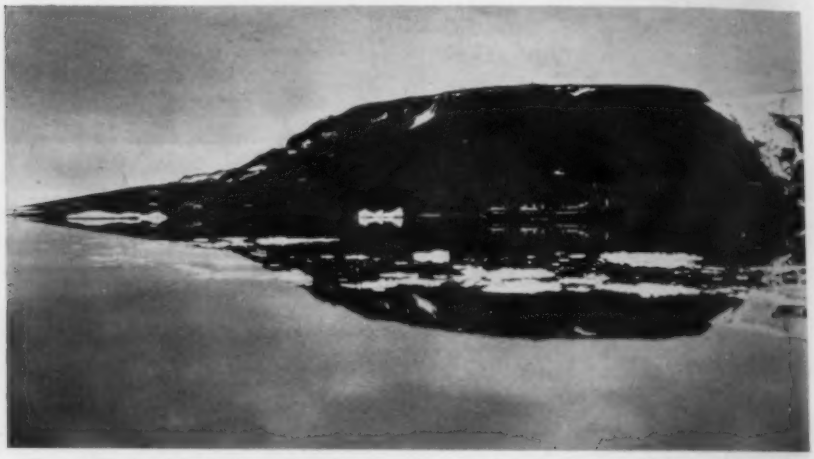


FIG. 4—Hooker Island, Franz Josef Land, rendezvous of the ice breaker *Malygin* with the *Graf Zeppelin*, July 27, 1931. The radio station lies on the low point of land on the left. (Photograph by Basse.)

Island, do not now exist—at least there were no traces of land in that direction as far as the horizon. The visibility was excellent too, and from our altitude we could plainly see forty miles or perhaps more.

Alexandra Island, except for a small part of its eastern half and three of its southern headlands, is completely covered with island ice. Thirty miles of its more or less regular northern coast line meet the sea in a vertical ice wall from ten to thirty feet in height. A slow movement of the ice cap, moreover, is indicated by the several small-sized growlers that were floating in the water near by. While we made a complete circuit of the island, one of the largest of the Franz Josef Land group, the photographers collected in about three hours enough material for the map. The geographical survey accomplished in this short period, so stated Professor Samoilovich, represented the equivalent of four summers' hard work for a ground party.

At 6.45 p. m. Ellsworth radioed a message to the American Geographical Society:

Met first ice in loose fields 120 miles south of British Channel. Now circling Alexandra Island. Present chart not correct. Albert Edward Island and Harmsworth Island do not exist.

[6] See the recently compiled map of Franz Josef Land on a scale of 1:750,000 accompanying "Franz Josef Land," *Trans. Inst. for Exploration of the North, No. 47*, Moscow, 1930, reviewed elsewhere in this number of the *Geographical Review*.

The camera survey of Alexandra Island and Prince George Island being completed, the airship was headed northeastward toward Crown Prince Rudolf Island, 85 miles away; the northernmost island in Franz Josef Land. Several rocky islets were observed in the offing of Rhodes Channel, although they are not recorded on present-day

FIG. 5—Cape Brorok, Crown Prince Rudolf Island, the most northerly member of the Franz Josef Land group. The land is completely covered with a low ice sheet. Even here a shore lane of open water was observed. (Photograph by Basse.)

maps. After we had passed Jackson Island the amount of open water appreciably decreased, and soon there was little or none to be seen. Along the coasts of Karl Alexander Island and Crown Prince Rudolf Island sea ice lay far up on the land, showing plainly that pack ice must often press in there from the northward. The most northerly point in the cruise was attained at midnight on rounding Cape Fligely, latitude 81° 50′, 490 nautical miles from the pole. Here was one of the most beautiful scenes of the trip, looking northward towards the midnight sun, then just below the horizon. All objects appeared to be bathed in the soft and mellow light except where a golden reflection shone brightly along a glittering, icy path between us and the pole.

We had gradually descended to the usual cruising altitude of 250 meters, and now the ship's head was kept off toward North Cape, the northern extremity of Severnaya Zemlya, Northern Land, 300 miles distant.[7] A half hour past midnight we passed over two very curious overlapping disks of ice, smoothly polished and one to three miles in diameter. This was Eva Island, low, double-mushroom-shaped, completely glaciated, and often probably overridden by sea ice. Another interesting feature in the solid pack, over which we were

[7] The former Nicholas II Land. For an account of the discovery see N. A. Transehe: The Siberian Sea Road: The Work of the Russian Hydrographical Expedition to the Arctic 1910–1915, *Geogr. Rev.*, Vol. 15, 1925, pp. 367–398.

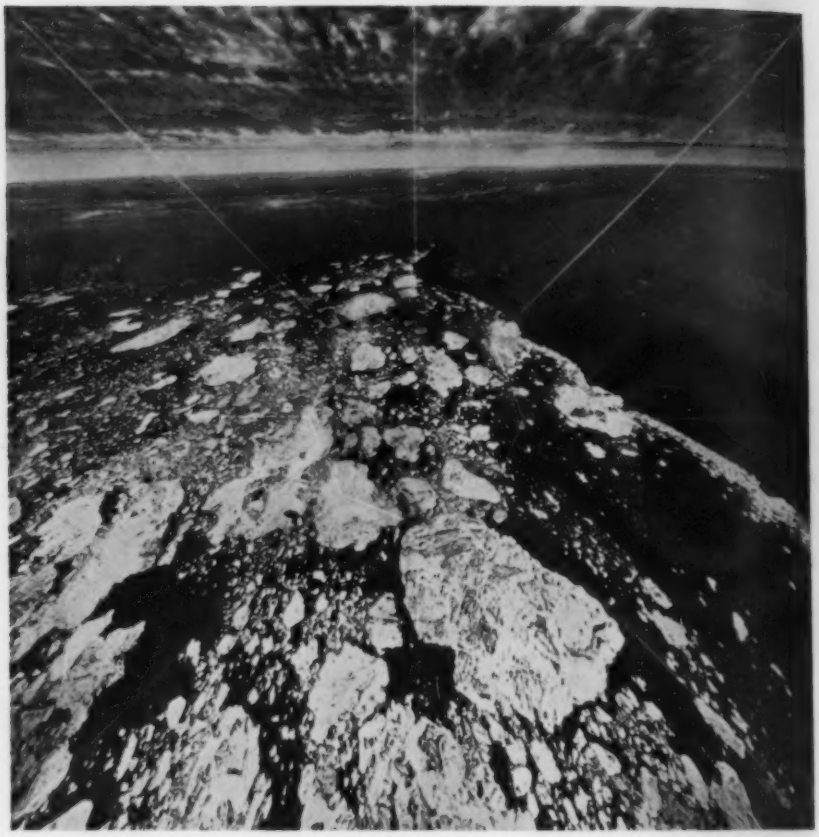


FIG. 6—Example of the aerial surveying work over the north coast of Alexandra Island, Franz Josef Land. (Photograph by C. Aschenbrenner.)

now flying, was patches of color ranging from dark muddy browns to greenish browns and yellows. These areas became so large and so numerous along the course between Franz Josef Land and Severnaya Zemlya that they neutralized the flat whiteness usually observed over ice fields in the north. Undoubtedly this color was the chlorophyll of algae and planktonic life that had blossomed and multiplied in the pools of thaw water. The upper surface of nearly all of the ice fields plainly showed the effects of much summer melting.

SEVERNAYA ZEMLYA (NORTHERN LAND)

Our course thence gradually diverged from the track taken by the dirigible *Italia* from Franz Josef Land to Severnaya Zemlya in 1928.[8] With the exception, therefore, of the drift of the *St. Anna* in longitude 71° 30′ E., 1912–1914, we were now blazing a new trail in

[8] See map accompanying the note "Nobile's Flights in the Arctic on the Airship *Italia*, May, 1928," *Geogr. Rev.*, Vol. 19, 1929, pp. 683–685.

FIG. 7—A glacier in northern Severnaya Zemlya. This view gives a good impression of the appearance of the land-and-ice-scape of Northern Land. The presence of a ridge in the bed of the glacier in the right foreground is marked by the lines of flow and indicates, furthermore, the relative thinness of the ice here. (Photograph by Aschenbrenner.)

the Arctic. No new island or other land was sighted on this leg of the cruise, however, and the principal object of interest was still the pack ice. As we approached Schmidt Island, discovered by the ice breaker *Sedov* the previous year,[9] and the western shores of Severnaya Zemlya, the sea ice became heavier, and its upper surface assumed a more rugged character than the ice around Franz Josef Land. From the gondola windows of the *Graf* at an altitude of 250 to 300 meters, the first pressure ridges, disjointed and scattered by previous disruptions of the floes, looked like mole mounds in size. The ice, in a belt about midway between Franz Josef Land and Severnaya Zemlya, appeared to be lighter, and the proportion of openings greater than elsewhere. Could this condition of the pack be traced to the influence of a warm current from the southwest pushing in from the open Barents Sea?

[9] Cf. B. Isachenko: The Arctic Expedition of 1930 on the Ice Breaker *Sedov*, *Geogr. Rev.*, Vol. 21, 1931, pp. 499–500.

A moderate breeze sprang up from the westward during the early morning of July 28 and, as a tail wind, increased the speed of the *Graf Zeppelin* to 65 miles per hour. About the same time we encountered a light fog. As Schmidt Island was neared the fog became thicker, and it was impossible to see this land at all. Later it cleared

FIG. 8—A glacier in northern Severnaya Zemlya flowing westward from the inland ice. Note the folding along the sides. (Photograph by Basse.)

somewhat, and at 5.30 a. m. the western headlands of Severnaya Zemlya were seen through the clouds. We rose again to about 4000 feet and flew southeastwards over the inland ice to the eastern coast near Cape Vilkitski. Most of this land that we were now exploring had never before been seen by man; at least so far as we know from existing records.

Severnaya Zemlya, in its northern part, is devoid of high mountains or alpine scenery. Its bare basalt headlands, with ice-worn tops and steep slopes, connect it to the same geological formation as Franz Josef Land. But there the similarity ends. Unlike the group of islands to the westward, the northwestern coast of Severnaya Zemlya is ice-locked the entire year. It is deeply intrenched in the polar cold, ice submerging all but the very tops of the uplands. Because of the absence of any great heights in this section of Severnaya Zemlya the glaciers gradually merge into the sea ice, and it is difficult to detect where the one leaves off and the other begins. Few or no icebergs can be produced under such conditions. Motion of the glaciers was well indicated in one place, however, where a projecting

tongue, pushing out into the sea ice, had cracked it apart for a long distance.

The northeastern side of Severnaya Zemlya appeared to be less icebound than the west. Several broad U-shaped valleys in the east were bare of snow, and through them ran streams of water, 50 to 100

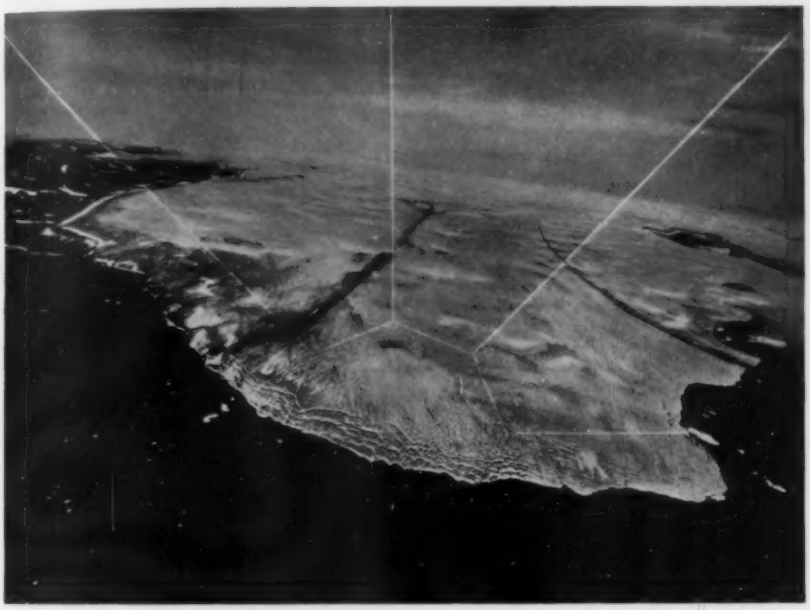


FIG. 9—Glacier entering the sea on the east coast of Novaya Zemlya. The width of the glacier is about seven kilometers. (Photograph by Aschenbrenner.)

meters wide, draining the inland ice. There was also a slight coloring to the valley bottoms, probably indicating the presence of mosses and lichens; but from our altitude of 3000 feet nothing certain can be stated. No animal life was to be seen. The northwestern slopes of Severnaya Zemlya are skirted in one place by a gently sloping coastal plain, the strandflat of the Norwegians, some 15 or 20 miles in width and in height several feet above the level of the sea ice. This may be evidence of previous transgression and subsequent uplift; such a movement has been recognized in the Taimyr Peninsula to the south.

About 7 a. m. the course was swung to the left, and it was announced we would pay a visit to Kamenev Island. This little island, located in latitude 79° 6′ N., longitude 97° 12′ E., about 15 miles off the western coast of Severnaya Zemlya, was discovered in 1930 by the Russian ice breaker *Sedov*. A radio and meteorological station has been established there, and it was an exploring party from Kamenev Island this spring that succeeded in making the first astronomical determination of the northernmost extremity of Severnaya Zemlya: latitude 81° 16′ N., longitude 95° 38′ E. On our approach to the

western coast, however, fog was encountered, and as it would be useless to attempt locating Kamenev Island under such conditions the dirigible was headed southward along the western coast line of Severnaya Zemlya.

The strandflat in this section, like that in the northwest, extends back as a broad, flat, raised shelf, some 10 or 20 miles in width. Many glacial streams in a myriad of tortuous patterns drain across it from the inland ice. At 9.50 a. m. we swung to the eastward and followed the western coast line where it forms a reëntrant opposite Schokalsky Bay on the east. No land could be seen bridging this gap, and from our altitude and position in the *Graf Zeppelin* the sea ice could be seen for several miles to the eastward without interruption. It is believed, therefore, that Schokalsky Bay is in reality a sound that transversely divides Severnaya Zemlya into two islands, oddly resembling the way in which Novaya Zemlya is cut midway of its longitudinal axis.

We proceeded southward to the southern extremity of Northern Land and Vilkitski Strait. Ellsworth radioed the following message to the American Geographical Society:

Surveyed southwest coast of Nicholas II Land this morning and find that Schokalsky Channel divides this ice-locked land into two large islands.

The Taimyr Peninsula

It took us one hour to cross the strait to Cape Chelyuskin, and because of fog we were unable to observe ice conditions therein. At 1 p. m. both the fog and the coast were left behind as we flew inland to clear atmosphere, approaching Taimyr Lake. It was astonishing to see the great change wrought by an hour's flight. The ice and snow of Severnaya Zemlya were now replaced by the dark browns, greens, and reds of the tundra country. Far to the eastward near the horizon could be discerned the rounded summits of an unmapped range of mountains. At 2 p. m. we began a camera survey of Taimyr Lake, heading westward parallel with its longest axis. Here on the tundra some of the first animal life of the cruise was seen. In several of the lakes birds as large as geese were feeding, and for many miles along our course to Dickson Harbor we flew over hundreds of reindeer. They were distributed either singly or in herds of as many as 30 or 40. Unfailingly they would scatter in every direction badly frightened by the approach of the airship. No signs of human life were perceived, and it is stated that the country north of the Byrranga Range, in these longitudes, is practically uninhabited by man and virtually unknown. The Taimyr Expedition of the Russian Academy of Sciences crossed farther south in 1928 on a route from Dudinka on the Yenisei River to the Khatanga and, striking north to Taimyr Lake, followed the southern shore of the lake to its eastern extrem-

ity.[10] As A. Tolmachev, leader of the expedition, points out, no exploration had been made in this interior country since Middendorff's expedition of 1843.

At 10 p. m., July 28, we arrived over the Russian trading post of Dickson. This place marks the normal navigational limit for ordinary trading steamers from the westward during the short sum-

FIG. 10—The northern end of Novaya Zemlya showing inland ice, the bare land belt, lanes of open water, the sea ice in the foreground. (Photograph by Basse.)

mer season. Three ships of the trawler type were moored to a small pier near the station, and a Dornier-Wahl seaplane was hauled up on the bank close by. The Soviet government maintains three of these planes on a summer patrol between Dickson and Vaigach for the safety of life and property. After dropping some sacks of potatoes and mail by parachute that had been intended for Kamenev Island station, we headed northwestward across Kara Sea for the northern end of Novaya Zemlya. A fifty-mile-wide belt of open water was traversed off Dickson before we came over loose and scattered *glaçons* of pack ice. The character of the ice was similar to that met south of Franz Josef Land two days previously—flat, free from pressure ridges, and also probably dating from last winter's freezing. Much of the ice, even 100 miles out from land, was covered with a deposit of dark brown mud; some of the *glaçons* seeming to be composed of as much mud as ice. Obviously this was ice formed either in the shallow bays or large rivers, or both, along the Russian coast. As we neared the Novaya Zemlya side of Kara Sea the ice became whiter and free

[10] A. Tolmachev: Die Taimyrexpedition der Akademie der Wissenschaften von U. S. S. R. im Jahre 1928, *Arktis*, Vol. 2, 1929, pp. 33–38.

FIG. 11—A small river delta on the east coast of Novaya Zemlya. Melting snow and drainage from the near-by inland ice form these tortuous streams across the bare strandflat. (Photograph by Basse.)

of mud, as well as more tightly packed together. A belt of open water five to ten miles in width separated the pack ice from the Novaya Zemlya coast.

NOVAYA ZEMLYA

At 4.30 a. m., July 29, we reached Cape Jelaniya, the northern tip of Novaya Zemlya; and, rising to 4000 feet, the *Graf* headed southwestwards along the longitudinal axis of the island to carry out a camera mapping survey en route. The northern end of Novaya Zemlya displays a bare coastal fringe five miles or more in width before the edge of the inland ice is met. Somewhat farther south, on the eastern coast, the inland ice extends directly to the sea as the four Nordenskiöld glaciers, in latitude 75° 30′ N. About fifty small bergs were scattered in the offing of the southernmost glacier of this group.[11] Directly inland from the Nordenskiöld glaciers the inland ice slopes rapidly upward towards a high ridge where only scattered summits here and there protrude above the surface. This was the first alpine scenery met on the voyage.

From the Nordenskiöld glaciers to Matochkin Shar, a distance of 200 miles, we skirted the eastern coast of Novaya Zemlya. It is estimated that ten glaciers were observed, and about two hundred icebergs that had calved were drifting in the coastal waters. Practically all of the icebergs were of small size, probably none over fifty to seventy-five feet in height, and most of them, considering their position with relation to the glaciers, appeared to be drifting southward more or less parallel to the coast.

[11] Compare R. Samoilovich: Explorations in Novaya Zemlya and the Barents Sea Executed by the Institute for the Exploration of the North, *Arktis*, Vol. 1, 1928, pp. 2–11. A full account in Russian is given in Novaya Zemlya, *Trans. Inst. for Exploration of the North, No. 40*, Moscow, 1929, reviewed elsewhere in this number of the *Geographical Review*.

At 8.30 a. m. we arrived off the entrance to Matochkin Shar and passed through to the Barents Sea end of the strait at 9.15. The channel presents beautiful scenery and affords a magnificent cross section of the folded rocks of this continuation of the Urals.[12] Our course from here doubled back to Schubert Bay on the east coast, and from there we headed southwestward for the southern cape of Gooseland, which we passed at noon. By this means the southern boundary of the inland ice was determined. It is interesting to compare these crossings with the ski crossing of Dr. Holtedahl's party at a very favorable location from Mashingi Fjord to Zwolke Fjord and back, which was accomplished in six days in the summer of 1921.[13]

FIG. 12—An old glacier bed in the northern extremity of Novaya Zemlya. (Photograph by Basse.)

The ship was now placed on 215° true, and with quartering winds from the north-northwest the speed was such that at 7 p. m. this same day we were passing over Archangel. Leningrad wished to greet us again; but at the last moment a stop was considered inadvisable, and we continued directly to Berlin. The *Graf Zeppelin* stopped at Templehof field for a half hour, then left for Friedrichshafen, the final destination, which was reached at 5 a. m., July 31, 1931.

Results of the Expedition[14]

Contributions to the Map

One of the most important contributions of the *Graf Zeppelin* expedition was the correction of existing maps. The installation of

[12] See O. T. Grønlie: Contributions to the Quaternary Geology of Novaya Zemlya, *Rept. of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921*, No. 21, Oslo, 1924; Olaf Holtedahl: On the Rock Formations of Novaya Zemlya, *ibid.*, No. 22, Oslo, 1928.

[13] Olaf Holtedahl: A Crossing of Novaya Zemlya, *Geogr. Journ.*, Vol. 59, 1922, pp. 370–375.

[14] Preliminary statements of results are the subject of several articles now appearing in appropriate scientific journals. The more detailed reports with data worked out will be published later in *Arktis*.

FIG. 13—The mountains of Novaya Zemlya. These tops protruded through the inland ice along the meridional ridge of the island. Note the shadow of the *Graf Zeppelin* on the ice. (Photograph by Basse.)

two of the latest approved German mapping cameras was one of the most important features of our equipment and marks, moreover, a great advance over previous aircraft expeditions to the Arctic.[15] Reference has already been made to the fact that Albert Edward and Harmsworth Islands, in the northwestern sector of Franz Josef Land, could not be found. A bare possibility, suggested by Eva Island, is that these islands, if similarly low and ice-covered, might likewise be screened by pack ice. Several small islets not recorded on present-day charts were discovered off the entrance to Rhodes Channel, but for that matter similar unknown islets undoubtedly lie scattered quite plentifully throughout the Franz Josef Land group. The subject of photogrammatic survey in Franz Josef Land was, particularly, Alexandra Land and a portion of Prince George Land.

The photogrammatic material secured by the *Graf Zeppelin* in Severnaya Zemlya consists of exposures from the northwest coast to Matusevich Bay, on the east coast, thence westward towards Kamenev Island, and then southward past Schokalsky Strait to Taimyr Lake. Fog was encountered along various parts of this track, so that it is not definitely known how much of this material is usable. No statement can yet be made regarding the location or the form of the unknown western half of Severnaya Zemlya. Only one navigational line of position was obtained in this region, and since it runs more or less normal to the general trend of the western coast it alone furnished little information. If the mosaic map of photographs can be referred to an astronomically known point, such as Matusevich Bay, then an

[15] A discussion of the method by Dr. Aschenbrenner will appear in a succeeding number of the *Geographical Review*.

FIG. 14

FIG. 15

FIGS. 14 and 15—Matochkin Shar (Matthew Strait), Novaya Zemlya. Figure 14 shows the eastern entrance, Figure 15 the northern side, of the strait. Figure 15, taken about halfway through the strait at an altitude of about 1000 meters, shows the height to which the meridional ridge of Novaya Zemlya rises. (Photographs by Aschenbrenner.)

area of considerable extent can safely be added to our existing maps. Naturally the results of this particular survey, covering one of the "blind spots" of the Arctic, will be awaited with particular interest.

Mountains about 1200 meters in elevation, unrecorded on our charts of Taimyr Peninsula, were sighted in the vicinity of latitude 75° 40′ N., longitude 101° 30′ E. The contour of Taimyr Lake on existing maps also will be modified somewhat by the photographs made from the *Graf Zeppelin*.

In Novaya Zemlya the northern and southern limits of the inland ice were photographed with the mapping cameras, as also were unrecorded mountain peaks that protrude through the ice along the meridional ridge of the island in its northern part. The unexplored section of the eastern coast of Novaya Zemlya for a distance of 120 miles from Rusanov Bay southward to Matochkin Shar was also the subject of survey.

Meteorological Data

The *Graf Zeppelin* expedition, unlike all other aircraft explorations of the Arctic, was made during midsummer, a season usually attended with much fog and low visibility. However, it seemed that given certain winds and pressure conditions this handicap could be avoided: and we were fortunate in being able to take advantage of favorable meteorological conditions.

Our start from Leningrad on the morning of July 26 was purposely delayed until the receipt of the morning observations. A disturbance of considerable intensity had been centered over Novaya Zemlya, giving Franz Josef Land a strong northeast gale. The morning's map showed an area of high pressure over the White Sea, while to the westward pressure was low from Norway towards Iceland. The fact that the disturbance in the Kara Sea was moving off to the eastward allowed us to begin the northward flight. Moreover, the sooner we started the better, for the easterly advance of another low from the direction of the Gulf Stream Drift would, it was predicted, bring low visibility and fog all too soon. Fortunately, such a development failed to materialize, and instead a large mass of polar air invaded southeastwards, forming a ridge of high pressure with the anticyclone previously noted near Archangel. The slow eastward movement of the pressure system during the following three days resulted in a high barometer and an unusually clear atmosphere for the region in which we worked. The winds were relatively light and always had a northerly component. Some restricted areas of fog were encountered, but they were always of small altitude, not much over 600 feet, with the top well defined. The construction of isobaric maps three times daily on the *Graf Zeppelin* is of the utmost importance: to take advantage

of the knowledge thus gained of the continually varying atmospheric conditions spells successful navigation with lighter-than-air craft.

The air temperatures at our altitudes in the Arctic varied from a minimum of 2.2° C., recorded somewhat south of Franz Josef Land to a maximum of 11° in the southern part of Novaya Zemlya. Considerable inversions were recorded by the thermometers, one of which was suspended at various distances below the dirigible, in a stream line metallic case. A routine meteorological record was maintained throughout the cruise.[16]

One of the most interesting instruments with which the *Graf* was equipped for this flight was the so-called Molchanov balloon, invented by Professor P. A. Molchanov.[17] Briefly, it consists of a large sounding balloon from which is suspended a case containing a small radio transmitter, thermometers, and a barometer. Connecting an electric battery circuit causes the changes in the temperature, the humidity, and the pressure to be communicated to the transmitter, which in turn broadcasts by radio a coded sequence of signals. Although such balloons with their apparatus have previously made several ascents, it was quite another matter to launch one successfully from the *Graf Zeppelin* with her five motor appendages. This problem was finally solved by weighting the Molchanov balloon and releasing it through a trapdoor near the keel of the mid-section of the ship. After dropping clear of the hull one hundred feet or so the weight was automatically loosed, and the balloon was free to begin its ascent. Of course, after the balloon is once released there is slight possibility that either the balloon or its instruments, costing at least two hundred dollars, will be recovered. Three successful ascents were made with Molchanov balloons during the Aeroarctic expedition: one east of Franz Josef Land, one over Severnaya Zemlya, and one in the vicinity of Vaigach Island.

Observations on Earth Magnetism

Throughout the flight frequent observations (every four hours north of Leningrad) were taken of the intensity of the horizontal force of the earth's magnetism. These determinations were made by means of the "double compass," loaned for use on the *Graf Zeppelin* Expedition by the Carnegie Institution of Terrestial Magnetism of Washington, D. C.[18] The *Italia* had a similar instrument which was lost when the dirigible was destroyed in the Arctic in May, 1928. The double compass, in order to record accurate determinations of

[16] See Fahrtbericht des "Graf Zeppelin," *Arktis*, Vol. 4, 1931, pp. 39–41.

[17] P. A. Molchanov: Problems and Methods in the Investigation of the Atmosphere in Arctic Regions, pp. 51–60 in "Transactions of the Second Polar Conference, Leningrad, June 18–23, 1928," Leningrad, 1930. [In Russian: the original report of the conference, which is less full, was published in German.]

[18] A description of the instrument and the results of earlier observations made on the *Graf Zeppelin* are contained in *Terrestrial Magnetism and Atmospheric Electricity* for December, 1930.

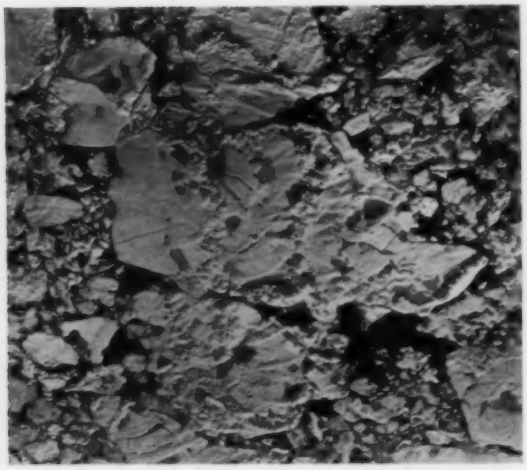


FIG. 16—Pack ice about 45 miles south of Franz Josef Land. The pools of water on the ice cakes indicate summer melting. (Photograph by Basse.)

the horizontal intensity, requires a steady platform. These conditions were for the most part satisfied on the *Graf Zeppelin* except when the ship was changing course or flying in bumpy air. Over the ice and water in the Arctic the air appeared to be very quiet, and double observations agreed, as a rule, within 0.0020 of the value of H with each other. In the vicinity of Severnaya Zemlya, where the horizontal intensity is weak, the accuracy of observations necessarily was less. The instrument was secured to the floor of the first cabin on the port side abaft the living-room quarters in the forward gondola of the *Graf*. In order to eliminate all local sources of attraction, aluminum berths were substituted for the iron ones in this room, and all other iron or steel objects were also removed.

A few determinations of the deviation of the total force of earth magnetism were also made, and these indicated a difference in many instances as great as two or three degrees from the values shown on the navigational charts.[19] In one locality a difference of six degrees was noted on the ship's magnetic compass from that which was printed on the chart, while another test in Franz Josef Land showed a close check between compass error and local variation. There was some speculation as to the action of the gyrocompass, with which the *Graf Zeppelin* is equipped, when we approached the northern end of our flight, it being stated that near the pole the gyro would vary considerably from the geographical meridian. Although we did not proceed farther north than latitude 82°, there was no appreciable failure.

OCEANOGRAPHY AND ICE OBSERVATION

Little or nothing could be undertaken in the oceanographical field. The original program of Aeroarctic's airship expedition under the leadership of Nansen reserved a prominent place for oceanography. It was proposed to lower sonic sounding apparatus from the belly of

[19] A letter from Dr. Ljungdahl states that he found errors in the deviation as great as 20° in the eastern part of our area.

the dirigible into open water areas of the polar cap ice and thus while the ship hovered there obtain the depth to the sea bottom. Because of the difficulties inherent in such maneuvering no observations of this nature were attempted in 1931. Subsurface oceanographic observations such as are made by a vessel at sea would, moreover, be quite impractical if not impossible to carry out from a dirigible either in the air or on the water.

FIG. 17—White Islands, Franz Josef Land. Note front of inland (glacial) ice and pack (sea) ice. (Photograph by Basse.)

On the other hand an excellent opportunity was afforded not only for immediate personal observation of the ice from a point of vantage but also for the securing of a permanent camera record for later study with greater care and at more leisure. The photographic material has yet to be arranged and classified under such headings and subheadings as: character, age, surface features, pattern, distribution, percentage of open water to ice, and drift.

One of the important results of the ice observation was to point out the conditions existing around the northern section of Severnaya Zemlya. Here we found the land completely ice-locked towards the sea, with the pack pushed in against the coast so tightly that it coalesced with the ends of the glaciers. The heaviest sea ice was found in the region adjacent to and northwest of northern Severnaya Zemlya. But even there the ice had not the rugged character belonging to the heavier, older polar cap ice. In fact the relative lightness and flatness of the sea ice over the entire length of our flight classified it as belonging to the pack-ice zone intermediate between the polar cap ice of the central basin and the fast ice of the coastal shelves.[20]

NAVIGATION

A total of 23 sun sights and one moon sight were taken during the flight. Weather conditions were unusually favorable for good observations except for temporary interruptions from fog. The sextant

[20] A more detailed report on the subject of ice observation will be published in this year's annual bulletin of the U. S. Coast Guard entitled "International Ice Observation, Ice Patrol, and Derelict Destruction Service (1931)."

used for measuring the altitudes was the bubble type manufactured by C. Plath of Hamburg, Germany. From experience with the use of a bubble sextant on shipboard it was found that a dirigible airship provides a much steadier platform. A skilled observer under ordinary air conditions on a dirigible is able to control the bubble to errors of altitude not greater than four or five minutes.

The American Geographical Society supplied us before the expedition started with polar projection charts, together with tables, and a celluloid template containing arcs of various altitude circles, all to be used in connection with a short method of polar navigation.[21] The simplification of this method rests largely on the selection of the geographical pole as the assumed position of the observer. Since we did not approach the pole nearer than latitude 81° 50′, the method was not considered so feasible. The facilities of navigational work on the *Graf Zeppelin* are practically the equal of that of a sea ship, and unlike an airplane there is ample table space for books, charts, and plotting instruments. Good results were obtained with the use of U. S. Hydrographic Office Publication No. 209 entitled "Position Tables for Aerial and Surface Navigation," and the lines of position were drawn in the usual manner on the ordinary plotting sheets embracing the required latitudes. Advantage was taken to cross the astronomical lines of position with isomagnetic lines of horizontal intensity from values determined by the double compass and guided by Fisk's charts,[22] but the reliability of the isomagnetic lines is, of course, questionable.

Conclusions

It is all too early yet to form any definite conclusions regarding the place the work of this expedition will take with other scientific investigations in the Arctic. It was designated as a preliminary cruise to a longer flight to take place either in the summer of 1932 or 1933. The U. S. Coast Guard, with its International Ice Patrol researches, is for one much interested in these airship investigations in the Arctic. It hopes to see a successful flight along the iceberg-glacier fronts of Baffin Bay and to realize a camera study of the iceberg distribution in West Greenland waters. The Aeroarctic Society deserves much praise for what has been accomplished: not only in outlining plans for a systematic study of the Arctic's many problems, but now as a result of patience and persistency, it may point with pride to this, its first expedition.

---

[21] This method is described in Sir Hubert Wilkins: The Flight from Alaska to Spitsbergen, 1928, and the Preliminary Flights of 1926 and 1927, *Geogr. Rev.*, Vol. 18, 1928, pp. 527–555.

[22] See Harlan W. Fisk: Isomagnetic Charts of the Arctic Area, *Trans. Amer. Geophys. Union, Twelfth Ann. Meeting, April 30 and May 1, 1931*, National Research Council, Washington, 1931, pp. 134–139.

NORWEGIAN EXPLORATIONS IN THE ANTARCTIC, 1930–1931

Gunnar Isachsen

[With separate map, Pl. I, facing p. 96]

Part I—Voyage of the "Norvegia"

AFTER an absence of almost four years, in which a distance of over 56,000 nautical miles was traveled, Consul Lars Christensen's research vessel *Norvegia* returned to Sandefjord on May 15, 1931.

On her first cruise in 1927–1928 exploratory work was carried out on Bouvet Island and in the waters thereabout and toward the south. During 1928–1929 the field of operations was much more extensive, covering the stretch from Bouvet west to 140° 49′ W.[1] The following season, 1929–1930, saw the notable discoveries of the Antarctic mainland from Enderby Land to Crown Princess Martha Land, described by the leader of the scientific work, Captain Riiser-Larsen, in the *Geographical Review* for October, 1930.

The plans for the *Norvegia's* fourth cruise, 1930–1931, had as its foremost objective a circumnavigation of the Antarctic. In addition the program included an investigation into the numbers and distribution of the whales of these southern waters, the customary hydrographic observations, and a search for various doubtful islands—Truls Island, the Nimrod Islands, Dougherty Island, and Pagoda Rock. Crew and equipment for the cruise were all on the way to Cape Town, where the *Norvegia* had been laid up since the preceding season, when Consul Christensen offered me the leadership of the expedition. Together with the expedition's oceanographer, Mr. Jens Eggvin, I arrived in Cape Town on September 22.

The Circumnavigation of the Antarctic

The *Norvegia* left Cape Town on October 4, 1930. The first iceberg was encountered at 52° S. On October 14 we passed Bouvet Island, and three days later at about 57° 40′ S. and 0° 28′ E. we met the factory ships *Thorshammer* and *Thor I* and coaled from the latter. Inasmuch as the circumnavigation had been scheduled to be completed in one season and the engine would thus have to be kept going uninterruptedly, several bunkerings were necessary on the way.

[1] For descriptions of these cruises see Bjarne Aagaard: Fangst og Forskning i Sydishavet (2 vols., Oslo, 1930), Vol. 2.

Our next coaling station was the *Falk*, at about 57° 15′ S. and 51° E. (Nov. 4 to 6). Then between December 2 and 3, at about 63° S. and 147° E., we took what coal we required from the *Kosmos*, the remainder being subsequently passed on to Dr. Mawson's expedition in the *Discovery*.

Between October 25 and 27 we had searched for Truls Island; from December 14 to 19 we searched for the Nimrod Islands, and from December 25 to 27 for Dougherty Island. Thence we proceeded to Peter I Island, at 68° 50′ S. and 90° 35′ W., where we intended to erect another hut for shipwrecked mariners in addition to the one put up by the *Norvegia* in 1928. The thick pack ice (Jan. 2), however, prevented us from approaching the island any closer than 36 nautical miles. Bellingshausen, who in 1821 discovered this island, the first land that had until then been seen to the south of the Antarctic Circle, was able to approach to within 15 miles of the island at that time, on January 22. Consul Christensen's expedition on the *Odd I* managed to get up to the island and to round it on January 17, 1927; and a landing was effected from the *Norvegia* on February 2, 1928. This year we had arrived too early and had no time to wait until the island again became accessible if we were to keep our rendezvous with Consul Christensen on the *Thorshavn* in the early part of February.

At Deception Harbor we took on coal between January 11 and 14. Our course then took us in an easterly direction, south of Elephant Island and Clarence Island, but the dense ice encountered there forced us to pass the South Orkneys on the north and to continue between Saunders and Montague of the South Sandwich Islands.

On January 29, when our position was 62° 44′ S. and 1° 34′ E., we had completed the circumnavigation. The distance covered by us since October 19 was about 11,500 nautical miles, accomplished in 102 days.

Thereupon, on February 2, with a full bunkering of coal, about 200 tons from the *Torodd* at 67° 40′ S. and 3° 30′ E., we continued southeastward making a reconnaissance as far as 69° 25′ S. and 26° 30′ E., off that part of the continental mainland later named Princess Ragnhild Land. On February 9 at 68° S. and 33° 53′ E. we encountered the *Thorshavn*. The writer and Mr. Eggvin returned on her with Consul Christensen to Cape Town, while Captain Riiser-Larsen took over the *Norvegia* to continue his charting of the previous season. The *Norvegia* proceeded slowly westward in search of a protected embayment in the ice from which the hydroplane, transferred from the *Thorshavn*, could take off. Such a place was found on February 16 in about 69° 26′ S. and 27° 41′ E. The following extracts from Captain Riiser-Larsen's diary tell the story of his flights during this part of the cruise (see inset, Pl. I).

Flights by Captain Riiser-Larsen

February 16. At 9.40 a. m. I got into the air with the master of the *Norvegia*, Captain Nils Larsen, as observer. . . . At 1000 meters I stopped climbing. Before this we had already seen land. Unfortunately, rather thick haze hung over the ice cover. I turned southward towards the land. . . . To the southwest the ice cap sloped upwards so quickly that I had no doubt there was land underneath it. To the south and east the front part of the ice seemed to be floating shelf ice. On account of the haze it was impossible to say how far off it started to rise. . . .

Turned west and passed over the *Norvegia* in order to have a less distant view of the "hill" to the southwest. I am sure this is the one that we had "appearance of" on several occasions in the previous days. At our altitude the westerly wind was so stiff that we advanced but slowly. After a flight of 80 minutes we landed by the *Norvegia*. . . .

February 17. At 4.30 a. m. we arrived at a bay where the floating factory *Torodd* was lying. . . .

As soon as we got into the air we saw open water and found this to be a big lane between the pack and the shelf ice. To the south the ice-covered land rose gradually. To the west a narrow channel of open water led to the longshore lane. Also east of south there was open water along the shelf wall. Between these two lanes a broad peninsula of unbroken sea ice came out from the shelf ice protected from the swell by stranded icebergs. I steered for the nearest land to the south and passed over this peninsula. The snow crests on unbroken ice showed that easterly winds were prevailing. The "track" of the grounded icebergs showed a westerly-going current. At 9.40 a. m. a couple of minutes after we had passed the edge of the inland ice I dropped the flag and documents, taking possession of the land for Norway.

At the altitude of 1100 meters there was a westerly wind. The distance from the *Norvegia* to the land I calculated to be 26 nautical miles. The coast was sketched in continuation of the land discovered yesterday. Today also there was haze over the shelf ice. . . . Unfortunately, therefore, we could not see far to the south.

I was quite convinced, however, that we were above ice-covered land and not above floating shelf ice. Close to the west of the point where the flag was dropped—S. 10° W. of the *Norvegia*—there was a long wedge in the ice. That was one proof. Another one was that the icebergs that were calving off were of curved contours with a rather short radius, indicating the contour of the land below. Neither here nor at the land of yesterday were there any nunataks. . . .

Landed on the pancake ice after a flight of 65 minutes. When

the plane was on board we proceeded eastwards. The bank of haze over the land could be seen from the deck. Position in the bay 68° 49′ S. and 30° 32′ E. Sounding 1050 meters. . . .

February 18. . . . Stopped at noon in 67° 53′ S. and 34° 36′ E. to await weather suitable for flying. . . .

February 19 . . . [In the evening] . . . our position was 68° 23′ S., 35° 00′ E. Yesterday I radioed H. M. the King of Norway asking permission to give the new land the name of His Majesty's grandchild, H. R. H. Princess Ragnhild. A radio back today graciously granted permission.

February 20. In the morning we stood for a short distance to the west to have a look at the bay in that direction. It was too open, however, to give shelter from the swell. We returned to await improvement of the weather conditions. . . . Good visibility to the south with that peculiar "land bank" of haze to the southwest.

February 21. . . . At 11.30 we were in the air and rose to 1100 meters. The land disappeared to the south at about 35° 00′ E. Steered towards this point, but everything farther south was covered in haze. To the east of this area there was sea covered with unbroken pack ice. Plenty of icebergs could be seen. On a couple of places to the southeast there was open water. Returned after a flight of 55 minutes. . . .

February 22. At 10.30 we passed the floating factory *Antarctic*. The master of the ship, Captain Borchgrevink, radiotelephoned to me that he had done some mapping of Enderby Land and Queen Maud Land. I therefore boarded the *Antarctic*. The mapping of the western part of Enderby Land confirmed our mapping last year. South of Cape Ann the coast disappeared out of sight from the *Antarctic*. Captain Borchgrevink got the coast again outside Queen Maud Land and had mapped the continuation of this land westwards from where we stopped last year and as far as 68° 30′ S., 40° 40′ E., where it sank below his horizon. As our observations yesterday also indicate, there seems to be an ocean bay between Queen Maud Land and Princess Ragnhild Land. Accordingly there should be a well sheltered bay at about the meridian of 40° E. We are now steering for this place. . . .

February 23. Arrived at the place during the night. . . . At 9.30 a. m. we got into the air and climbed to an altitude of 1000 meters. Here we were close under thick clouds. The western side of Queen Maud Land we could see very well. It was a steep coast from where it hove into sight to the east of us. To the south of us it ran out in a lower cape. South of this it disappeared. Beyond the cape south and southwestwards we observed unbroken sea ice. In the horizon partly covered in haze I believed I saw the peculiar light over the shelf ice westwards.

Completion of the Cruise

After the flying had been concluded Captain Riiser-Larsen left on a transport for Cape Town, while the *Norvegia* in command of Captain Nils Larsen proceeded to the reported position of Pagoda Rock. No rock, however, was seen; and the *Norvegia* went on to Bouvet Island, where it transpired that the two houses set up in 1929 had disappeared. The house on Cap de la Circoncision, at a height of about fifteen meters above sea level, was most probably carried off by "screwed-up" ocean ice, and the house on Lars Island was possibly blown away in a gale. The *Norvegia* thereupon left for the return to Sandefjord, via Cape Town where, as previously stated, she arrived on May 15.

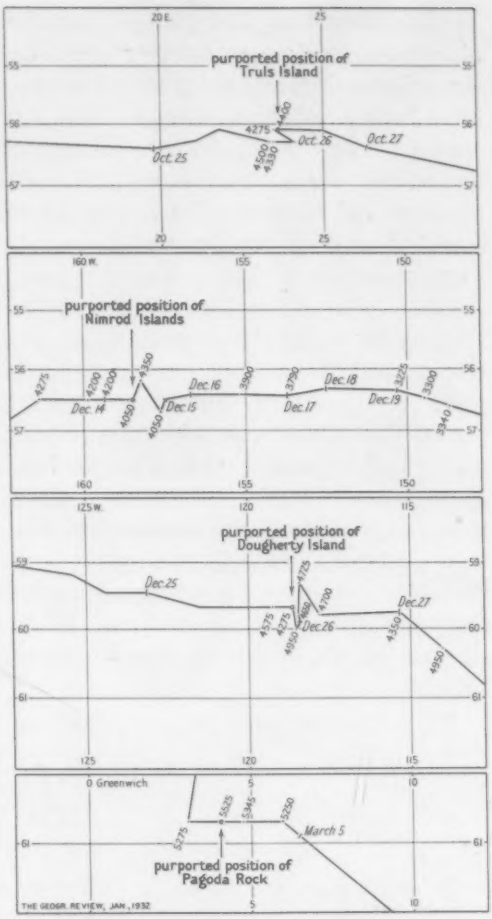


FIG. 1—Sketch maps showing the course of the *Norvegia* in her search for Truls Island, the Nimrod Islands, Dougherty Island, and Pagoda Rock, respectively.

Search for Doubtful Islands

The history of Bouvet Island, so long in the doubtful class, is a warrant for the careful examination of all cases of doubtful islands. Among these, the *Norvegia* had the opportunity of investigating Truls Island, the Nimrod Islands, Dougherty Island and Pagoda Rock.

Truls Island was reported as seen from the whaler *Truls* in January, 1930, at 56° 07′ S. and 23° 39′ E.; the height of the island was stated as 33 meters.

We searched in vain for it in clear weather, our positions being:

October 25 . . . . 56° 26′ S. and 19° 49′ E.
26 . . . . 56° 19′ S. and 24° 05′ E.
27 . . . . 56° 25′ S. and 26° 19′ E.

The crow's nest of the *Norvegia* was at a height of 23 meters above sea level; our visibility distance therefrom was thus at least 9 nautical miles; and if the island were about 33 meters high, it should have been seen at a distance of not less than 21 nautical miles. As shown in the sketch, the island does not appear in the position submitted nor within a distance of 21 nautical miles from our course line between 15° E. and 27° E. The depth in the position named was sounded as 4400 meters, and surrounding depths varied from 4275 to 4500 meters.

The Nimrod Islands are supposed to have been seen by Captain Eilbeck on board the *Nimrod* in 1828, at 56° 20′ S. and 158° 30′ W. Great numbers of birds were seen in these waters, and considerable maritime vegetation. In 1831 these islands were unsuccessfully sought for by Captain Biscoe. In 1909 Shackleton on the *Nimrod* sounded a depth of 2050 meters at 16 nautical miles to the east of the position named; and the Scott expedition on the *Terra Nova* searched for it in 1913, also without success. Neither did the American research ship *Carnegie*, which in 1915 went past the indicated position at a distance of 40 nautical miles, see anything of these islands; and the steamer *Arabia* went over the spot in 1922 without observing anything.

Our search, in visible weather, was also in vain, our positions being:

December 14	56° 20′ S. and 159° 21′ W.
15	56° 20′ S. and 157° 32′ W.
16	56° 25′ S. and 156° 44′ W.
17	56° 27′ S. and 153° 43′ W.
18	56° 19′ S. and 152° 30′ W.
19	56° 20′ S. and 150° 16′ W.

If the height of these islands is assumed as being 10 meters, we should have seen them at a distance of at least 15 nautical miles. As can be seen from the sketch, the islands are not located in the position submitted nor within a distance of 15 nautical miles from our course line between 161½° W. and 151° W. The depth in the position furnished was 4050 meters, and six different soundings near the spot gave a depth of from 3900 to 4275 meters.

Dougherty Island, whose existence, writes Lieutenant Commander Gould[2] in 1928, "is still a strictly open question," was reported in 1841 as seen at 59° 20′ S. and 120° 20′ W. by the whaler *James Stewart*, Captain Dougherty, who passed the island at a distance of about 300 meters. The island was supposed to be 5 nautical miles northeast-southwest, quite high in the northeast but low in the southwest, and having a snow-filled section in the middle.

In the year 1800 Captain Swain reported having seen an island

[2] R. T. Gould: Oddities: a Book of Unexplained Facts, London, 1928, pp. 225–233.

at 59° 0′ S. and 90° 0′ W. Fanning gives the position at 59° 30′ S. and 100° W. There were many birds and seals on the island, which was covered with ice and snow. In 1859 Captain Keates reported having seen an island of a dark color, 24 meters high, at 59° 21′ S. and 119° 7′ W. Mr. Stannard on the bark *Cingalese* stated that he was at the island during three days in 1886 and described it as being 90 meters high and free from snow and vegetation, position 59° 20′ S. and 120° 18′ W.

Other, and unsuccessful, searches were made by the *Rimutaka*, Captain Greenstreet, in 1894, 1900, 1902, 1907, and 1910; by Captain Scott on the *Discovery* in 1904; by Shackleton in 1909; by the *Carnegie* in 1915; and by the *Norvegia* in her 1928–1929 cruise,[3] the last-named at the instigation of Mr. H. J. Bull.[4] However, the time at the disposition of the *Norvegia* in 1928 was not sufficient to ascertain whether the island was to be found in the position given by Mr. Bull—59° 48′ S. and 118° 40′ W., on information supplied from a Captain White from New Zealand, who stated he had sailed around the island in 1893. After looking into the matter, Mr. Bull was so certain the island did actually exist that in 1914 he requested and obtained a license from the British government for the purpose of utilizing the island in question.

Our search was prosecuted in good visibility, our positions being:

December 25 . . . . 59° 28′ S. and 123° 07′ W.
26 . . . . 59° 53′ S. and 118° 29′ W.
27 . . . . 59° 44′ S. and 115° 20′ W.

If the height of the island is estimated at 25 meters, we should have seen it at a distance of at least 19 nautical miles. As will be observed from the sketch, the island does not appear in the locations furnished us nor within a distance of not less than 19 nautical miles from our course line between 121½° W. and 115° W. The depth at the position indicated by Mr. Bull was 4275 meters, and five soundings in the surrounding waters gave a depth of from 4350 to 4950 meters.

Along the stretches of water on which we searched for these doubtful islands we did not encounter greater numbers of seal or birds than was usual, and only minor fragments of kelp were seen in the water.

The *Norvegia* also investigated the case of Pagoda Rock, "a large rocky islet, surmounted by a quantity of snow and ice," which was

[3] Bjarne Aagaard, *op. cit.*, Vol. 2, pp. 664–672.

[4] The *Discovery*, on her return to England from Hobart, Tasmania, under Captain K. N. Mackenzie, after the completion of Sir Douglas Mawson's Antarctic expedition of 1930–1931, set her course over the alleged position of Dougherty Island but found only deep water, sounding 2470 fathoms (4516 meters) a few miles east of her noon position of 59° 23′ S. and 120° 45′ W. on May 22, 1931 (*New York Times*, May 28, 1931: see also "Geographical Record" in this number of the *Review*).

reported seen by the *Pagoda*, Captain Moore, in 1845. Moore gave the position of the island as 60° 11′ S., and 4° 43′ E. At this spot the *Quest* in 1922 sounded 5308 meters, and the *Meteor* in 1926 sounded 5467 meters in the neighborhood. The *Norvegia* took the position 60° 42′ S. and 4° 3′ E. computed by Walter Dickson in "The Antarctic Voyage of H. M. Hired Barque 'Pagoda' (1844–1845)," *United Service Magazine*, London, 1850. Search was conducted up to 57 nautical miles east and 31 nautical miles west from the position without result and in weather of good visibility. In the indicated position soundings gave a depth of 5525 meters, and east and west likewise depths of over 5000 meters.

Inasmuch as probable errors in calculating the positions given us were eliminated by the manner in which our investigations were carried out, it must be taken for granted that all these doubtful islands were nothing but drifting icebergs.

Oceanographic and Meteorologic Observations

During the circumnavigation 54 oceanographic stations were taken, most of them to a depth of 2000 meters. Of these, 12 were in the southern Indian Ocean, 26 in the southern Pacific, and 16 in the southern Atlantic (see Pl. 1). Where the sequence of the stations is interrupted, this is to be ascribed to bad weather. The southern Pacific is so little known from a hydrographic standpoint that particular stress was laid on the establishment there of as many stations as possible. From 115° W. to the South Shetlands three sections were run consecutively; one from 60° S. and 115° 20′ W. toward the southeast as far as the pack-ice edge, 36 nautical miles north of Peter I Island; another from the edge of the pack ice there and toward the north to 66° 50′ S.; and a third in an easterly direction from 91° 33′ W. A section was also run from 56° 30′ S. and 158° 30′ W. to 58° 20′ S. and 138° 31′ W.

Water samples for salinity determinations were taken home for titration, while the determinations of the phosphate and nitrate contents were carried out on board with a Sund calorimeter, which permits the work to be done even in unruly weather. Altogether there were collected 1100 salinity samples, 200 micro-plankton samples, 380 phosphate samples, 120 nitrate samples, and 152 oxygen samples.

In the case of a number of these stations vertical plankton hauls were taken at various depths from the surface down to 600 meters. In some places samples were taken from still greater depths, in addition to a number of bottom samples.

For the soundings, numbering 120 altogether, we used Behm's echo sounder, which, however, is difficult to handle on a small vessel

when the sea runs high, as it then becomes hard to distinguish the echo from other disturbing noises. At station 52, 65° S. and 2° 35′ E., on January 30 we could not use the echo sounder, as the stop watch had ceased to function; but, as the charts showed a depth of 4000 meters in this vicinity, we went confidently ahead with our routine work, until the samplers struck bottom. By means of a hand sounder the depth was made out to be 1200 meters, and the bottom showed sand and shell. Unfortunately, time did not permit us to make a thorough sounding of the Maud Bank, as we named it after Roald Amundsen's ship.

During the entire cruise drift bottles were sent out daily. The edge of the drift ice was found to be considerably farther south this year than in previous years—in the Bouvet section and eastward to 60° E. as much as 200 nautical miles. Of icebergs of minor proportions we saw many every day, but bergs were most numerous and largest in the stretch from the South Orkneys to somewhat beyond the South Sandwich Islands. Along this stretch we would see daily anywhere from 100 to 200 small and medium-sized icebergs at one time. Here we also saw the largest tabular berg encountered on the trip; presumably it was as much as 40 nautical miles long. Icebergs with sand or dirt on them we encountered hardly more than ten times on the entire voyage. It is possible that most of these, maybe all of them, were bergs that had turned over, or "blue icers," which in a certain light appeared as more or less dark-colored.

The only icebergs I had seen carrying sand and stones during the previous season, 1929–1930, were in the neighborhood of Bouvet Island and in Bransfield Strait.

Meteorological observations were taken regularly. The average cloudiness was 9. Breeze followed breeze, with short intermissions, until January 10. Of storms we had one in each of the months October, November, and December. From January 10 to February 9, when I left the *Norvegia*, the weather was calm and fine as it probably seldom is in the Antarctic. During the storm at the beginning of November the barometer fell to 719 millimeters. The lowest barometric reading we were able to verify was 718 millimeters, on November 20 at 58° S. and 94° E. The most usual wind directions were south, west, and northwest. Among the drift ice the air temperature maintained itself between −1.1° and −2.3° C. We had −4° during four days only.

Whales in Antarctic Waters

Theories as to the numbers and distribution of whales are readily advanced, but to substantiate them is not by any means easy. It is extremely doubtful whether definite "whaling grounds" can be counted on in the Antarctic, such as exist in the Arctic where condi-

FIG. 2

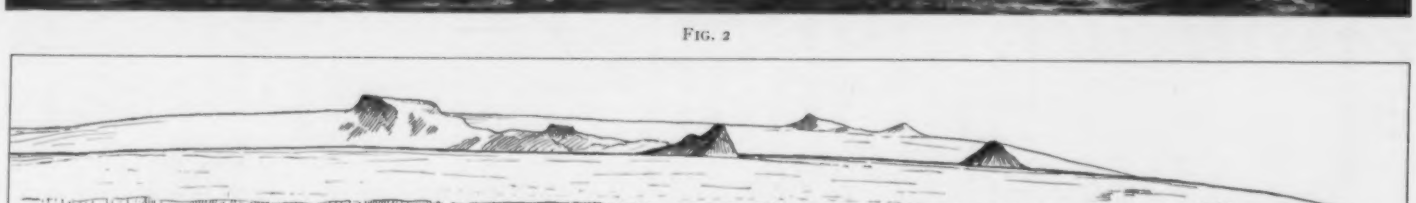


FIG. 3

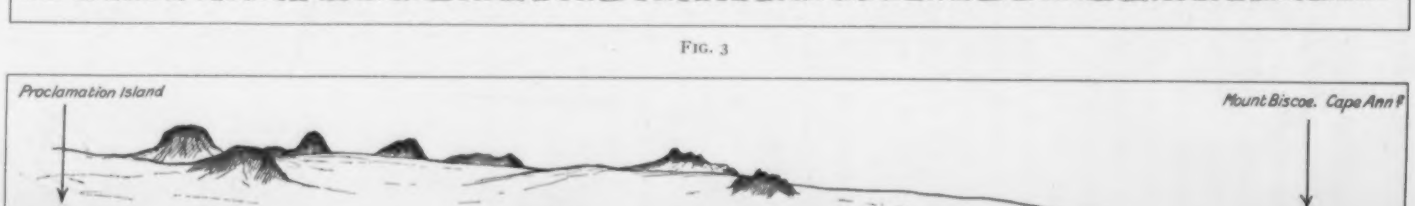


FIG. 4

FIG. 2—Panorama in Lars Christensen Land, 68° 15′ S. On the left Mt. Torlyn, on the right Mt. Karius Mikkelsen and beyond Mt. Gustav Bull (see Pl. I).
FIG. 3—The Aker Peaks from a point 66° 13′ S. and 58° 19′ E., 10 nautical miles from the shelf ice. (From a sketch by O. Borchgrevink.)
FIG. 4—Enderby Land from Proclamation Island to Cape Ann (Mt. Biscoe ?) from a point 8 nautical miles off the coast. (From a sketch by O. Borchgrevink.)

tions determining the feeding grounds of the whale seem to be more simple and uniform.

The fact that whales have not been sighted along a certain stretch of water is far from being sufficient to settle the question, for the sighting of whales is contingent on many things, the foremost one being the weather. When there is a breeze the blowings of the whales are seldom seen. But as far as our investigations went they confirmed the assertion that in the Antarctic region there is no such thing as a "whale section." A special journal was kept during the voyage on the types of whales that were encountered, on their numbers, and on the direction in which they were traveling.[5]

Part II—Norwegian Contributions to the Map of the Antarctic, 1930–1931

The coast line of Antarctica between 75° E. and 18° W., shown on the inset Plate I, as well as the underscored soundings in the adjacent waters are based on the observations and investigations that were undertaken by the motor-tanker *Thorshavn*, the floating factory *Thorshammer*, the whale-catchers *Torlyn* and *Thorgaut*, the expeditionary vessel *Norvegia*, and the floating factories *Antarctic* and *Sevilla* during the field season of 1930–1931 and by the *Norvegia* in 1929–1930. They are incorporated in the two new Norwegian hydrographic charts which, on Consul Lars Christensen's initiative, have been worked out by Captain H. E. Hansen and published by the Whalers' Mutual Insurance Association.[6]

The *Thorshavn*, with Consul Christensen himself on board, and the *Thorshammer* sounded a new bank, called the Fram Bank, between 75° E. and 67° 10′ E. south of 66° 40′ S., with depths from 750 to 161 meters, bottom rock and clay. The *Torlyn* later on was able to sound greater depths on the southeast, landward, side of this bank; hence possibly the "bank" in reality is a submarine ridge sticking out toward the northeast from the promontory called Bjerkö Headland on the map.

Lars Christensen Land

Lars Christensen Land between 75° E. and 60° E. has been seen by at least three different whaling crews during the season of 1930–1931. Captain Reidar Bjerkö on the whale-catcher *Bouvet 2* followed the land in an easterly direction from approximately 64° E. on January 19, 1931, and succeeding days. Captain Carl Sjövold on the *Bouvet 3*

[5] The final reports of the cruise will be published by the Norwegian Academy of Sciences in Oslo, as separate publications under the title "Scientific Results of the Norwegian Antarctic Expeditions 1927–1931, Instituted and Financed by Consul Lars Christensen."

[6] Sydishavet fra 50° til 73° S. Br. og fra 20° V. til 100° Ö Lgd., scale 1 : 4,000,000 in lat. 60° S., 2 sheets, *Kommandör Chr. Christensens Hvalfangstmuseum*, Publ. No. 10, 1931.

followed a day after Captain Bjerkö. The land rose slightly toward the south and was entirely ice-covered. In the west, toward Kemp Land, at approximately 62° E. the land became considerably higher, and several nunataks protruded from the surface. Islands and rocks at about 25 nautical miles from land were observed by Captain Walter of the *Thorgaut* and Captain Mikkelsen of the *Torlyn*, while Captain Sjövold saw rocks and grounded icebergs on a line with the Douglas Islands and toward the southeast. Proceeding thence in an easterly direction, Captain Sjövold observed two high volcanoes, which were later named the Sjövold Peaks. This was on January 25 and from 68° S. and 74° E. Both the volcanic cones projected as black masses from out the surrounding ice-covered landscape, and from both issued strong columns of smoke blowing to the westward.

Lars Christensen Land is shown on Plate I[7] mainly after the investigations of Captain Mikkelsen of the *Torlyn*. Proceeding from a point in 67° 03′ S. and 73° 44′ E., soundings were carried in a southerly direction toward land, where, as already noted, were found greater depths than over the Fram Bank, and then southwesterly. Land was reached at 68° 50′ S. and 71° E. in clear weather. Between February 13 and 15 Captain Mikkelsen followed the coast toward the west, as far as 66° 20′ and 61° 40′ E., hugging the shore at a distance of approximately 3–8 nautical miles up to 63° E. and then receding from it. In front of the tongue of land, later named Bjerkö Headland, that projects at 68° S. and 69° E. he had slowly to feel his way with the catcher among a large number of grounded icebergs, in openings from 15 to 30 meters wide.

On this whole stretch the inland ice reached the sea, terminating in ice cliffs. Rock was exposed only at a couple of places, namely at the head of the small bay about 69° S. and 70° 25′ E. and at the place marked on the map at 68° 10′ S. and 69° E. where Mikkelsen went ashore.

From 68° E. the land runs in a westerly direction. At 66° E. there are two parallel rock ridges, Mt. Torlyn and Mt. Klarius Mikkelsen, running out to the sea at a distance one from the other of 10 nautical miles. A bare strand was also observed at about 5 nautical miles to the east of Mt. Torlyn. At about 10 nautical miles to the

[7] This is practically coextensive in longitude with Mawson's MacRobertson Land, a name applied by him on his 1929–1930 expedition to the segment east of 60° E. (*Geogr. Rev.*, Vol. 20, 1930, p. 552) and extended on his 1930–1931 expedition (*New York Times*, March 20, 1931) to include Thorshavn Bay (Mawson's Mackenzie Sea). During the 1930–1931 expedition (see "Geographical Record" in the present issue) Mawson followed the coast westward to 61½° E., making several landings, two on February 13, 1931, in about 67½° and 66½° E., and on February 18 in 61½° E. As the present article shows, the Norwegians skirted this coast eastward on January 19–20, 1931, and westward on February 14 and 15, 1931. Although Mawson first saw MacRobertson Land in January, 1930, it now appears from the Norwegian observations reported in the present paper that the coast line as sketched from his airplane flights (*Geogr. Rev.*, Vol. 20, 1930, Pl. 6, opp. p. 552) lay a degree of latitude too far north as he now realizes himself (*New York Times*, March 20, 1931). Correction of the earlier observations together with a report of the work of Mawson's 1930–1931 expedition will appear in the *Geographical Review* when the results have been worked out.—EDIT. NOTE.

west of Mt. Mikkelsen and more or less at a right angle therewith, there is another ridge named Mt. Gustav Bull. To the south and the west of the three peaks several nunataks were seen.

The coast line from 65° E. to 60° E. has been drawn after a map sketch by Captain Rolf Walter, who followed the land westward ahead of the *Torlyn*. Captain Walter's sketch shows several larger and smaller islands at a distance of from 20 to 30 nautical miles from the coast. The *Torlyn* also met with several islets on its way from the coast back to the *Thorshammer*. These islands and islets have not been set down on the chart, as their location is as yet too uncertain.

Kemp Land and Enderby Land

Several whaling parties have operated at different times during the past season off the coast of Kemp Land, between 60° and 58° E. It is an ice-cliff coast, the ice rising inland to great heights and showing nunataks. For this section of the map a sketch by whaling-inspector Captain Daehli has been used.

The position of the coast line between 59° E. on Kemp Land and 51½° on Enderby Land was determined by Captain O. Borchgrevink of the floating factory *Antarctic*. The weather was good, and Captain Borchgrevink took many observations on the sun as well as on the stars. The distance of the ship from the land at the time of the observations was ascertained by sending one of the whaling boats ashore at various points. The location of the Aker Peaks, named after the farm of Director Svend Foyn Bruun of the Antarctic Whaling Company at Tönsberg, and the peaks to the northwest was determined approximately by sending a whaling boat to a distance of 10 nautical miles from the *Antarctic* and by measuring from both vessels the angle subtended by the other vessel and the peaks. Bearings and vertical angles to these cliffs were also taken from the *Antarctic*, and in determining the heights the curvature of the earth's surface was taken into consideration.

The position of the *Antarctic* for observations on the western Aker Peak was 66° 20′ S. and 58° 34′ E.; for the eastern peak it was 66° 12′ S. and 58° 10′ E.; for summits to the northwest of the Aker Peaks it was 65° 29′ S. and 52° 31′ E.

The most westerly point on the coast line thus constructed, the position of which is 66° S. and 51½° E., is probably identical with Biscoe's Cape Ann and with Mawson's Mt. Biscoe,[8] the first part of the Antarctic continent to be sighted, seen by John Biscoe in 1831. The cape is a bare peak, falling off abruptly on all sides, including the land side.

[8] Compare the photographs in the *Geographical Review*, Vol. 20, 1930, of Mt. Biscoe by Mawson, Fig. 12, p. 549, and of Cape Ann by Riiser-Larsen, Fig. 10, p. 563. Mawson's position is in close agreement, 66° 13′ S. and 51° 25′ E.—Edit. Note.

Queen Maud Land and Princess Ragnhild Land

Queen Maud Land, between 50° E. and 37° E., was mapped from Captain Riiser-Larsen's flights during the *Norvegia's* expeditions of 1929–1930 and 1930–1931. On Plate I, the eastern section, which was mapped in 1929–1930, has been shifted somewhat to the north, in accordance with Captain Borchgrevink's observations during the last season between 44° E. and 41° E. and the conference thereon between Captains Riiser-Larsen and Borchgrevink.

Princess Ragnhild Land, between 37° E. and 10° E., was discovered by Captain H. Halvorsen on the floating factory *Sevilla*, who was off this coast February 9 to March 7, 1931. The coast line was charted by Captains Riiser-Larsen and Nils Larsen, in four flights from the *Norvegia*, namely: on February 16, from 69° 26′ S. and 27° 24′ E.; on February 17, from 68° 49′ S. and 30° 32′ E.; on February 21, from 68° 7′ S. and 34° 10′ E.; and on February 23, from 68° 15′ S. and 39° 7′ E.

In the course of the first two flights the coast line was drawn from 24° E. to 33½° E., and during the last two flights it was established that the land runs in a southerly direction in a large bay between Princess Ragnhild Land and Queen Maud Land.

The western portion of Princess Ragnhild Land, between 24° E. and 10° E., is on the basis of Captain Halvorsen's observations from the *Sevilla* from March 8 to April 7, 1931.

Crown Princess Martha Land

The eastern section of Crown Princess Martha Land from 10° E. to 0°, is also based upon Captain Halvorsen's observations. The *Sevilla* operated last season between 42° E. and 9° W., as a rule at a distance of from 5 to 30 nautical miles from the shelf ice; but in the western part of this section she was as much as 60 nautical miles from the shelf ice. The representation of the coast between 0° and 8° W. is hence conjectural only. The western section of Crown Princess Martha Land, from 8° W. to 18° W., was charted by Captain Riiser-Larsen in 1929–1930.

It was Shackleton's goal on his expedition with the *Quest* to map the unknown coast line between Coats Land and Enderby Land. The expedition under the leadership of Wild, after Shackleton's death, reached the position 69° 18′ and 17° 11′ E. (1922) but without seeing land. During the seasons 1929–1930 and 1930–1931, and under comparatively favorable ice conditions in the latter, it has finally been possible to map the main features of this stretch.

MAP SHOWING THE FIELD OF OPERATIONS OF THE "NORVEGIA" ANTARCTIC EXPEDITION OF 1930-1931

Major GUNNAR ISACHSEN in command
(followed by Commander H. RIISER-LARSEN after the circumnavigation)

Scale 1:25,000,000

Kilometers 100 0 100 200 300 400 500 600 700
Statute miles 100 0 100 200 300 400

Jan.20 21 22 23 — Track of the "Norvegia" with dates of noon positions, oceanographical stations (⊛), and echo soundings in meters (·2900)

Submarine depths (in meters)
0 500 1000 2000 3000 4000 5000 6000 7000 8000

·650 Depth of soundings in meters
Argentine Basin — Names of major features of submarine relief
·2213 Spot heights on land in meters
Inland ice
Glaciers
Shelf ice
Observed stretches of pack ice (with date)
Extreme limit of drifting sea ice (essentially according to Haardt)

Base: American Geographical Society's Bathymetric Map of the Antarctic, 1:20,000,000, Dec. 1929, revised Nov. 1931

20 130 30 120 110 100 West of 90 Greenwich 80 70 60

40 50 60 70 80 90 120 130 140 150 160 170

Eastern Island Rise

Pacific Ocean

Antarctic Basin

Argentine Basin

Puerto Montt
Buenos Aires
Magellanes
Falkland Islands (British)
Stanley
Cape Horn
DRAKE STRAIT
Coaled Jan. 11-14
SOUTH SHETLAND ARCHIPELAGO
South Shetlands
Coaled Jan. 5
BELGICA SEA (BELLINGSHAUSEN SEA)
Peter I Island
Alexander I Land
Charcot I.
Adelaide
Anvers I.
Brabant I.
Joinville I.
James Ross I.
Coaled Jan. 19
South Orkneys
Jan. 20
HEARST LAND
WEDDELL SEA
FALKLAND ISLANDS DEPENDENCIES (British)
South Sandwich Is.
Dec. 25
Dec. 20
Dec. 15
Dec. 10
ANTARCTIC CIRCLE
Idsel Ford Mountains
MARIE BYRD LAND
KING EDWARD VII LD.
C. Colbeck
Little America (Framheim)
Bay of Whales
ROSS SEA
ROSS DEPENDENCY
Chatham Is. (British)
Pitt I.
Wedddell Sea Shelf Ice
Luitpold Land
Caird Land
Coats Land
Crown Princess Martha Coast

Copyright, 1932, by the American Geographical Society of New York

CONTINENT
ANTARCTIC BASIN
INDIAN OCEAN
PACIFIC OCEAN
AUSTRALIA
NEW ZEALAND
TASMANIA
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
QUEENSLAND
NORTHERN TERRITORY
Australian Basin
East Australian Basin
Tasman Basin
Campbell Plateau
Balleny Is.
Scott I.
Macquarie I.
Auckland Is.
Stewart I.
Lyttelton
Dunedin
Christchurch
Wellington
Nelson
Hobart
Launceston
Melbourne
Adelaide
Albany
Geraldton
Fremantle
Perth
Broken Hill
Mt Isa
Darwin
Alice Springs
Cairns
Townsville
Brisbane
Sydney
Newcastle
Canberra
Port Augusta
Kalgoorlie
Esperance
Port Hedland
Broome
Derby
Kununurra
Tennant Creek
Mt Gambier
Mildura
Bourke
Dubbo
Orange
Wagga Wagga
Albury
Griffith
Deniliquin
Hay
Cobar
Wilcannia
Broken Hill
Port Pirie
Whyalla
Ceduna
Eucla
Norseman
Kalgoorlie
Coolgardie
Leonora
Laverton
Meekatharra
Carnarvon
Geraldton
Shark Bay
Exmouth
Onslow
Roebourne
Port Hedland
Broome
Derby
Wyndham
Kununurra
Halls Creek
Tennant Creek
Alice Springs
Oodnadatta
Marree
Birdsville
Innamincka
Cooper Creek
Lake Eyre
Lake Frome
Lake Torrens
Lake Gairdner
Lake Amadeus
Lake Mackay
Lake Macdonald
Lake Nash
Lake Mueller
Lake Callabonna
Lake Blanche
Lake Gregory
Lake Disappointment
Lake Barlee
Lake Carnegie
Lake Rason
Lake Wells
Lake Ballard
Lake Lefroy
Lake Cowan
Lake Moore
Lake Grace
Lake Brown
Lake Varley
Lake Yeo
Lake Bryde
Lake Gregory
Lake Stretch
Lake Argyle
Lake Kununurra
Lake Woods

West of 90 Greenwich

SOUTH AMERICA

URUGUAY

Buenos Aires

Montevideo

Rio de Janeiro

Bahia

Puerto Montt

Magallanes

Cape Horn

Falkland Islands (British)

Stanley

DRAKE STRAIT

Rio Grande Ridge

Argentine Basin

Brazilian Basin

SOUTH ATLANTIC OCEAN

PACIFIC OCEAN

Pacific Antarctic Basin

Island Rise

BELGICA (BELLINGSHAUSEN) SEA

ANTARCTIC ARCHIPELAGO

Coaled Jan. 11-14

South Shetlands

Antwerp I.

Brabant I.

Adelaide I.

Alexander I.

Charcot I.

Peter I. Island

Jan. 1 1931

Jan. 5

Dec. 25

ANTARCTIC CIRCLE

HEARST LAND

WEDDELL SEA

FALKLAND ISLANDS DEPENDENCIES (British)

South Orkneys

South Georgia

Jan. 20

South Sandwich Is.

South Sandwich Trench

Jan. 25

Coaled from "THOR I"

Oct. 15

Coaled from "TOROOD"

Maud Bank

Mar. 10-15

Bouvet I.

Oct. 20

Edsel Ford Mountains

MARIE BYRD LAND

KING EDWARD VII LD.

C. Colbeck

Little America

Bay of Whales

ROSS DEPENDENCY (British)

ROSS SEA

ROSS SHELF ICE

Queen Alexandra Mts.

Mt. Markham

1st Albert Markham

Ross Island

McMurdo Sound

Barne Inlet

Barne Glacier

Shackleton Inlet

Shackleton Glacier

Beardmore Glacier

Liv. Glacier

Amundsen Glacier

Scott Glacier

Queen Maud Mts.

LUITPOLD LD.

CAIRD LD.

COATS LD.

CROWN PRINCESS MARTHA LAND

Weddell Sea Ice Shelf Ice

Emperor Ernst B.

Wilhelm II Coast

Princess Martha Coast

Coats Land

BRUCE 1904

ROSS 1843

Cape Norvegia

NORVEGIA Feb. 16, 1930

BELLINGSHAUSEN

SEVILLA Jan. 28, 1931

QUEST 1922

Ice Shelf

Ice Barrier

Ice Tongue

Ice Islands

Ice Cliffs

Ice Foot

Ice Rises

Ice Rumples

Ice Ridges

Ice Hummocks

Ice Pressure Ridges

Ice Pinnacles

Ice Caves

Ice Tunnels

Ice Grottoes

Ice Arches

Ice Bridges

Ice Crevasses

Ice Fissures

Ice Chasms

Ice Moraines

Ice Floes

Ice Pans

Ice Fields

Ice Floe Edge

Ice Blink

Ice Streams

Ice Drift

Ice Packs

Ice Floe Trails

Ice Floe Lanes

Ice Floe Leads

Ice Floe Polynyas

Ice Floe Openings

Ice Floe Channels

Ice Floe Canals

Ice Floe Basins

Ice Floe Bays

Ice Floe Coves

Ice Floe Inlets

Ice Floe Outlets

Ice Floe Straits

Ice Floe Sounds

Ice Floe Gulfs

Ice Floe Seas

Ice Floe Oceans

Ice Floe Continents

Ice Floe Islands

Ice Floe Peninsulas

Ice Floe Capes

Ice Floe Points

Ice Floe Headlands

Ice Floe Bluffs

Ice Floe Cliffs

Ice Floe Slopes

Ice Floe Valleys

Ice Floe Ridges

Ice Floe Mountains

Ice Floe Hills

Ice Floe Plateaus

Ice Floe Plains

Ice Floe Deserts

Ice Floe Tundras

Ice Floe Forests

Ice Floe Jungles

Ice Floe Swamps

Ice Floe Marshes

Ice Floe Bogs

Ice Floe Fens

Ice Floe Moors

Ice Floe Heaths

Ice Floe Meadows

Ice Floe Pastures

Ice Floe Fields

Ice Floe Orchards

Ice Floe Vineyards

Ice Floe Gardens

Ice Floe Parks

Ice Floe Cemeteries

Ice Floe Churches

Ice Floe Schools

Ice Floe Hospitals

Ice Floe Libraries

Ice Floe Museums

Ice Floe Theaters

Ice Floe Stadiums

Ice Floe Arenas

Ice Floe Auditoriums

Ice Floe Concert Halls

Ice Floe Opera Houses

Ice Floe Ballrooms

Ice Floe Dance Halls

Ice Floe Nightclubs

Ice Floe Bars

Ice Floe Restaurants

Ice Floe Cafes

Ice Floe Hotels

Ice Floe Motels

Ice Floe Inns

Ice Floe Taverns

Ice Floe Pubs

Ice Floe Breweries

Ice Floe Distilleries

Ice Floe Wineries

Ice Floe Vineyards

Ice Floe Orchards

Ice Floe Gardens

Ice Floe Parks

Ice Floe Cemeteries

Ice Floe Churches

Ice Floe Schools

Ice Floe Hospitals

Ice Floe Libraries

Ice Floe Museums

Ice Floe Theaters

Ice Floe Stadiums

Ice Floe Arenas

Ice Floe Auditoriums

Ice Floe Concert Halls

Ice Floe Opera Houses

Ice Floe Ballrooms

Ice Floe Dance Halls

Ice Floe Nightclubs

Ice Floe Bars

Ice Floe Restaurants

Ice Floe Cafes

Ice Floe Hotels

Ice Floe Motels

Ice Floe Inns

Ice Floe Taverns

Ice Floe Pubs

Ice Floe Breweries

Ice Floe Distilleries

Ice Floe Wineries

THE COASTAL BELT OF THE ANTARCTIC CONTINENT BETWEEN 75° E AND 18° W

BASED ON NORWEGIAN OBSERVATIONS AND DISCOVERIES DURING THE FIELD SEASONS OF 1929-1930 AND 1930-1931

Scale 1:11,500,000

Kilometers 50 0 50 100 150 200 250 300 350 — Statute miles 50 0 50 100 150 200

- Track of the research vessel "Norvegia," Jan. 30 - March 3, 1931
- Airplane flights by Commander H. Riiser-Larsen
- Track of the whale catcher "Torlyn," Feb. 12-16, 1931
- Track of the floating factory "Thorshammer," Jan. 12 - April 4, 1931
- 4725 Soundings by Norwegian expeditions (in meters)
- 2069 Other soundings (in meters)
- ⊙ Farthest advanced positions of Norwegian vessels
- ⊕ Other farthest advanced positions

CONTINENT

ANTARCTIC CIRCLE

PRINCESS RAGNHILD LAND

QUEEN MAUD LAND

ENDERBY LAND

LARS CHRISTENSEN LAND

KEMP LD.

KAISER WILHELM II LAND

QUEEN MARY LAND

WILKES LAND

BANZARE LAND

SOUTH VICTORIA LAND

KING GEORGE V LAND

Atlantic-Indian Rise

Crozet Ridge

Kerguelen-Gaussberg Ridge

Kerguelen (French)

Heard I. (French and British claims)

Mc Donald I.

Maud Bank

Gunnerus Bank

Meteor Bank

Sjövold Peaks (active volcanoes)

Douglas Is.

Proclamation I.

White I.

Ice Bay

Thorshavn Bay

Fram Bank

Cape Ann

Aker Peaks

Discovery Inlet

Shackleton Inlet

Davis Sea

Ross Island

Mt. Erebus

Mt. Terror

Mt. Albert Markham

Mt. Barr Smith

Mt. Gaussberg

Mt. Torlyn

Mt. Gustav Bull

Mt. Hannes Halvorsen

Mt. Sjögren

Mt. Thorshavn

Mt. Wilhelm

Mt. Wilkes

Mt. Banzare

Mt. Sabrina

Mt. Ingrid Christensen

Mt. Menier

Mt. Harmsworth

Mt. Markham

Mt. Nansen

Mt. Bellingshausen

Mt. Biscoe

Mt. Kemp

Mt. Valdivia

Mt. Moore

Mt. Cook

Mt. Sevilla

Mt. Quest

Mt. Norvegia

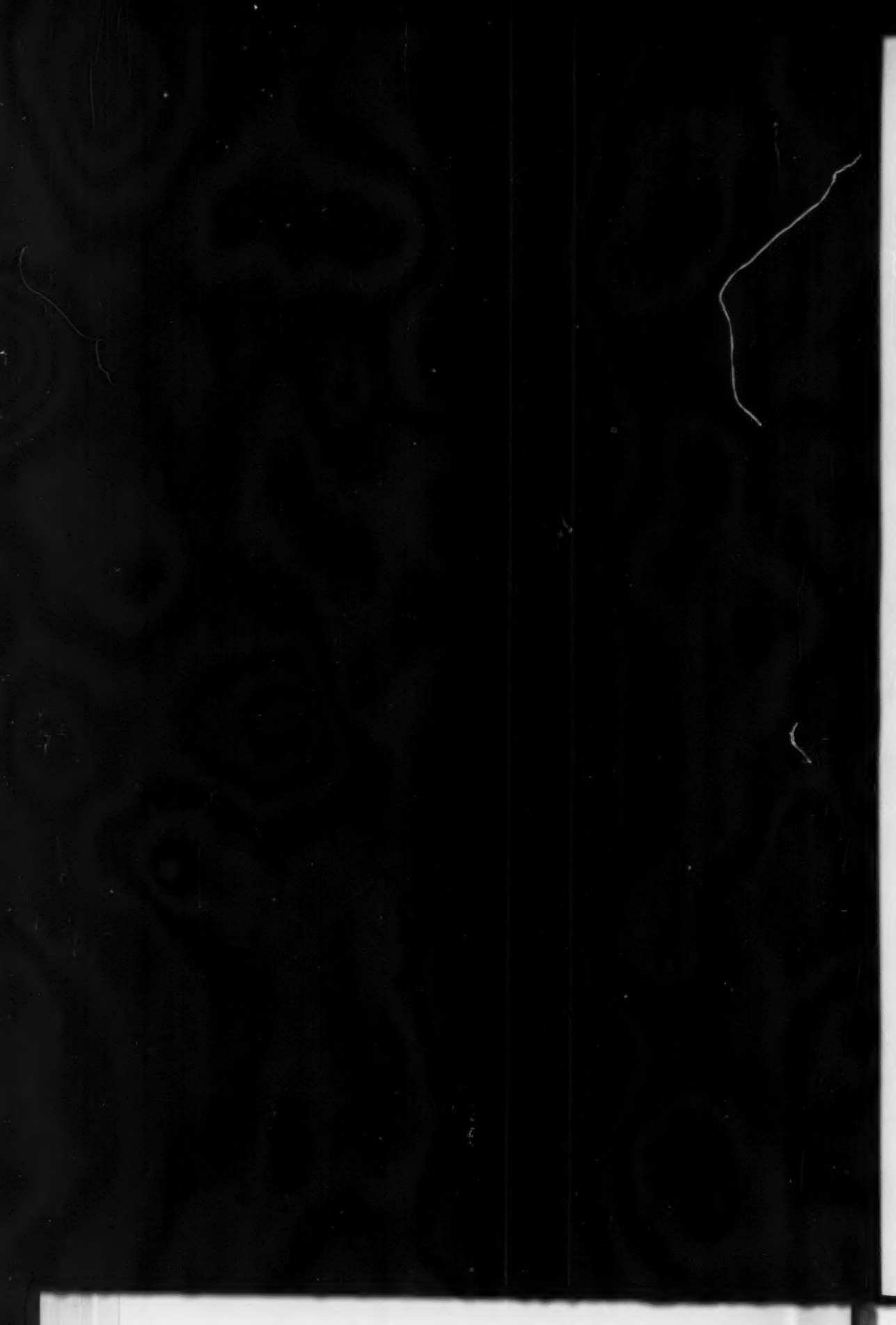
Mt. Torlyn

Mt. Thorshavn

Mt. Gustav Bull

Mt. Hannes Halvorsen

Mt. Sjögren



THE DESICCATION PROBLEM IN WEST AFRICA: THE CAPTURE OF THE SOUROU BY THE BLACK VOLTA

R. H. Forbes

CAPTURES in various stages of completion occur in the river systems of West Africa. In this region, where steeper coastal slopes adjoin comparatively level interior drainages, the process of river capture is still active and is one of the factors contributing to the desiccation of this part of Africa. In many cases the capture is complete, or nearly so, as in the classic instance of the Niger; in others it is under way, as shown in this reconnaissance;[1] in still others it is threatened, as where the Benue is thrusting a tentacle into the drainage of Lake Chad.

European nations can hardly look without concern upon the increasing desiccation of a continent that supplies them with important quantities of raw materials, and it is hoped that a pioneering demonstration, as in the case of the Sourou, of the possibilities of capture prevention may result, ultimately, in more extensive conservation elsewhere.

The bend of the upper Black Volta is due to the capture, not yet complete, of the Sourou by the lower Black Volta, a more aggressive coastal stream. This bend lies within, and roughly concentric with, the great bend of the Niger and on a small scale illustrates a phase of the capture, now approaching completion, of the Niger itself.

The Ancient Sourou

The original Sourou rose in about latitude 11° N. and longitude 5° W. (Greenwich), flowed in a northerly direction, and probably joined the Bani River, a branch of the Niger, south of Mopti.[2] The topography as seen from the Mopti-San road is apparently in harmony with such a drainage. Farther south, in the northeastern part of the Ivory Coast, the Bougouri River, an eroding stream resembling the Black Volta, shows a similar bend due, possibly, to the capture of one of the ancient tributaries of the Sourou by a minor branch of the Black Volta. The general topography, as viewed from a moun-

[1] Compare Schwarz's observations in the Kalahari.

[2] The possibility of other courses is discussed by Henry Hubert: Sur un important phénomène de capture dans l'Afrique occidentale, *Ann. de Géogr.*, Vol. 21, 1912, pp. 251–262. See also Kurt Niehoff: Oberflächengestaltung, Niederschlag und Abfluss des Niger und seiner Nachbargebiete, *Mitt. aus den Deutschen Schutzgebieten*, Vol. 30, 1917, pp. 339–403.—Edit. Note.

tain side at the crest of the Bougouri bend, seems favorable to the theory of such a capture here. The ancient Sourou therefore was a considerable river draining an extensive region northward at a time when the Niger may have replenished an inland sea.

Ordinarily stream capture is explained by the back-cutting of a river channel into the basin of the captured stream; but another powerful agency has operated along the desert border of the Sudan. This agency is the Sahara, whose advancing dunes during a period of desiccation in recent geological time have unquestionably crowded the Niger southward out of those inland deltaic channels whose traces have now been surveyed in connection with the French Middle-Niger irrigation projects.[3] In like manner the Sourou, whose lower reaches lay well within the territory covered by the last Saharan advance, may have been blocked by dune sands and its waters crowded eastward over the lip of its basin into that of the Black Volta. A belt of fixed dunes, in fact, extends along the southern face of the Falaise, a line of cliffs extending from southwest to northeast across the probable course of the lower Sourou. The Falaise itself is a remarkable upthrust of faulted sandstone, much broken at its western end with gaps through one of which the Sourou may have found its way to the Bani (Fig. 6).

FIG. 1—Waterfall 11 kilometers from Banfora on the steeper slope towards the coast. October 14, 1930.

The writer was stationed for nearly a year (1929–1930) at Dédougou within the bend of the Black Volta and took advantage of the opportunity to establish gauges on that stream and on the Sourou. The possibility of arresting the capture of the Sourou and of partially restoring the flow now lost to the Volta was considered. Such a project would conserve large quantities of water for livestock and for irrigation in a considerable region now short of water for several months of the dry season each year.

SOUROU AND UPPER BLACK VOLTA COMPARED

The Sourou and the upper Black Volta are opposites in character. The Volta flows in a deep and narrow channel, its banks densely over-

[3] Cf. Le Sahara vaincu, peut-il être dompté? L'aménagement du Sahara, *Annales Acad. des Sci. Coloniales*, Vol. 4, 1929.—EDIT. NOTE.

grown with a tangle of thorny brushwood, lianes, and occasional large trees. At high flood, in the vicinity of its junction with the Sourou, the river averages about 40 meters in width and 5 meters in extreme depth, carrying a maximum of about 120 cubic meters of water a second.

The fringe of brushwood at the water's edge is infested with tsetse

FIG. 2—View from a low bluff at the crest of the Volta bend near the Sourou junction, looking northeast over flat country. January 8, 1930.

flies both those carrying human sleeping-sickness infection and those affecting horses and cattle. Since the appearance of sleeping sickness along the river, native villages have nearly all been moved to a safe distance from the banks of the stream, leaving it in possession of hippopotami and crocodiles and an alongshore population of lion, leopard, gazelle, koba, monkeys, snakes, and guinea fowl. The river is rich in fishes, including the excellent capitaine of the Niger; but, with the exception of occasional trap fishing, the natives make little use of it, probably for fear of the tsetse. Ferryways and fords are usually cleared of brush for a short distance on each side to destroy the lurking places of the flies and minimize the danger to passers-by.

In contrast to this evil river the Sourou, extending northward from its junction with the Black Volta, opens out into a series of wide shallow lakelets filled with rich *borgou*[4] pasturage and bordered by grassy savanas. Some of these lakelets carry water through the winter season. Others and the shallower connecting channels go dry until, with the advent of the next rainy season, the Black Volta again overflows into the Sourou.

Curiously, the Sourou is connected with the Black Volta by a

[4] *Borgou* is an aquatic grass which grows in quiet waters of interior French West Africa. Botanically it is related to the sorghums.

double mouth. The upstream mouth presumably intakes the northward flow; the downstream mouth was seen (January 8, 1930) carrying the return flow into the Black Volta. The two mouths are separated by a small island of sediments carrying a growth of brushwood and trees.

Aquatic life moves with the current. As the flood rises hippos go north along the Sourou, and the villagers enjoy a fishing season. When the flood falls the hippos retreat to the deeper waters of the Black Volta, while the crocodiles and the lepidosirens bury themselves in mud until the next flood. Tsetse flies are much less abundant along the lakelet margins of the Sourou; hence native villages remain in their old locations, and cattle are kept close to water supplies through the dry season.

In general the Sourou, filled with *borgou* grass and bordered by open level savanas, resembles the lacustrine region of the Middle Niger to which it was once tributary.

Hydrographic Observations

Flood-water gauges were established by the writer at the Dédougou-San bridge across the Black Volta, about 45 kilometers above the junction of the Volta and the Sourou, and at the old Léra bridge about 8 kilometers north of the junction. Stream measurements were made at both these points and at the Dédougou-Tougan ferry, about 60 kilometers below the junction. Observations from August, 1929, to July, 1930, were frequent enough to give satisfactory flood-water curves and to show quantitative relations between the Volta and the Sourou during the northward and the southward flows of the latter stream. In January, 1930, a pirogue voyage from the Léra bridge to the Tougan ferry was made in observation of these wild and jungle-bound reaches of water and to sound the river channels en route.

Good roads connected the three gauging stations so that with auto transport all three measurements could be made within 24 hours of each other. Depths were measured with a heavily weighted sounding line corrected for slant and wetting; velocities by surface floats sometimes doubled by submerged checks attached by a cord. All observations were repeated at 3-to-5-meter intervals across the stream.

Gauge-height readings are shown by the accompanying curves. That for the Black Volta, carrying the larger amount of water in a confined channel, is higher and steeper than that for the Sourou, which receives only one sixth of the Volta flow. Both curves rise steadily and without setbacks until the end of the monsoon season. The last heavy rain for the period under observation occurred November 4, with the highest gauge reading on November 16. The smooth-

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Cattle and balansan trees at Di on the Sourou. January 6, 1930.

FIG. 4—The Sourou at Di, wide and comparatively deep. Water usually holds over here between floods. At this time, January 6, 1930, the water level was some 20 centimeters below the maximum. About half a century ago the maximum was approximately 1 meter higher.

FIG. 5—Borgou marshes in the Sourou at Yayo. Lakelet 4 meters deep, maximum, January 6, 1930.

ness of the Volta curve and, consequently, that of the Sourou, is due to the thickly grassed watershed, within which there is very little cultivated land. The comparatively gentle gradient of what was formerly an interior drainage towards the Niger is also a factor in regularizing the river.

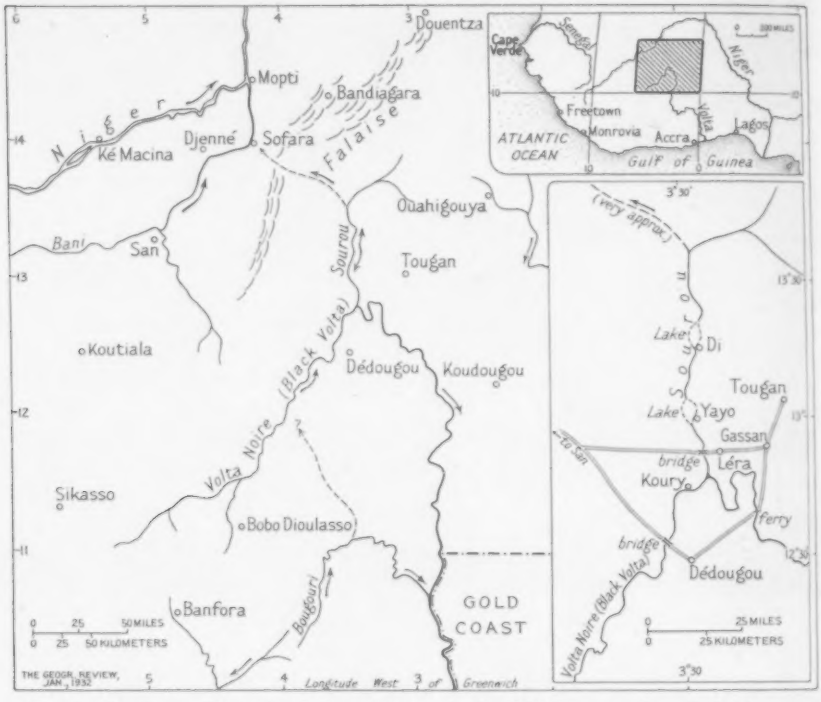


FIG. 6—Sketch map illustrating drainage relations in the Volta-Sourou region. Probable courses of ancient drainages shown by broken lines. The upper inset shows the situation of the area in west Africa. The lower inset shows the region about the junction of the Volta and Sourou in greater detail.

The two curves and the measurements of flow (Fig. 7) show that, beginning probably late in July with the rise of the upper Black Volta after the opening of the rainy season, a part of its flow is diverted into its ancient channel—the Sourou. This diversion begins vigorously, reaches its peak about October 1, and then decreases as the flat gradients of the old river fill with water.

In mid-November the Volta begins to fall, at which time the flow of the Sourou northward has greatly slackened. In December the Sourou comes to a halt, then reverses, and early in January is flowing vigorously back into the Volta with a current that decreases as the lakelet reservoirs are partially emptied. This backward flow did not entirely cease in 1930, a trickle of water continuing until the northward flow began again, completing the yearly cycle.

Measurements of the Volta above the junction, minus the Sourou

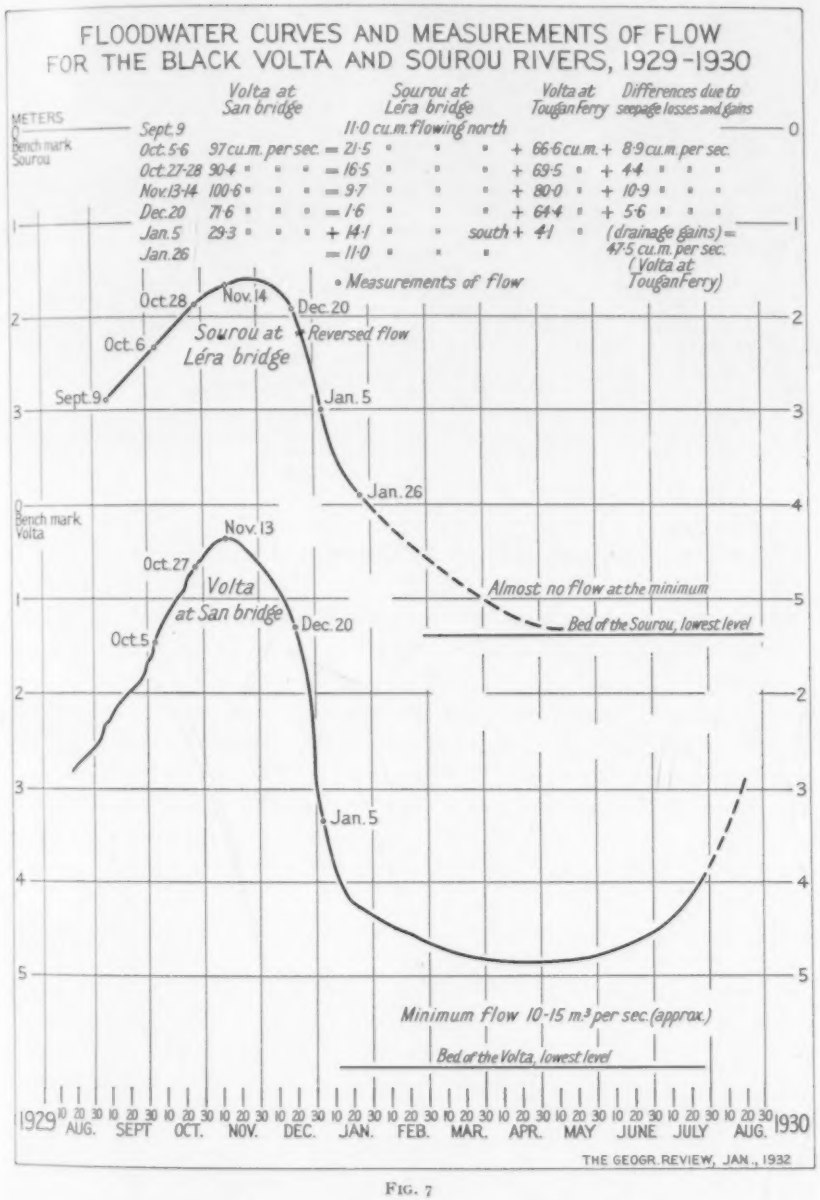

FLOODWATER CURVES AND MEASUREMENTS OF FLOW
FOR THE BLACK VOLTA AND SOUROU RIVERS, 1929-1930
Volta at San bridge
Sourou at Léra bridge
Volta at Tougan Ferry
Differences due to seepage losses and gains
METERS
Bench mark Sourou
Sept. 9
Oct. 5-6 97 cu.m. per sec. = 21·5 + 66·6 cu.m. + 8·9 cu.m. per sec.
Oct. 27-28 90·4 = 16·5 + 69·5 + 4·4
Nov. 13-14 100·6 = 9·7 + 80·0 + 10·9
Dec. 20 71·6 = 1·6 + 64·4 + 5·6
Jan. 5 29·3 = + 14·1 south + 4·1 (drainage gains) = 47·5 cu.m. per sec. (Volta at Tougan Ferry)
Jan. 26 = 11·0
11·0 cu.m. flowing north
Measurements of flow
Oct. 28
Nov. 14
Dec. 20
Oct. 6
Sourou at Léra bridge
Reversed flow
Sept. 9
Jan. 5
Jan. 26
Bench mark Volta
Nov. 13
Oct. 27
Volta at San bridge
Almost no flow at the minimum
Bed of the Sourou, lowest level
Oct. 5
Dec. 20
Jan. 5
Minimum flow 10-15 m.³ per sec. (approx.)
Bed of the Volta, lowest level
1929 AUG. SEPT OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY JUNE JULY AUG. 1930
THE GEOGR. REVIEW, JAN., 1932

FIG. 7

diversion or plus the Sourou reversion, do not tally exactly with the Volta below the junction. This is due, when the Volta is rising, to seepage and overbank losses and, when the Volta is falling, to drainage gains.

The total amounts of water carried by the Black Volta and the Sourou during the year of observation may be approximated by means

FIG. 8—The Sourou flowing from the Volta, looking north from Léra bridge in direction of the current. September 9, 1929.

of the gauge height curves and the several measurements of flow made at the San and Léra bridges. For the Black Volta above the Sourou this amounts to about 1,490,000,000 cubic meters of water for the year. Of this amount about 245,000,000 cubic meters were delivered to the Sourou from July to December 24 (approximately)—of which about 75,000,000 cubic meters were returned to the Volta during the remaining months of the cycle. In other words, for the year of observation one sixth of the upper Volta drainage was delivered into the Sourou, and one third of this sixth reverted to the Volta.

There is evidence that this 90 per cent net total capture will be complete within a comparatively short time. The channel of the

FIG. 9—The Sourou flowing towards the Volta (looking north from Léra bridge against the current from same point as Fig. 8). The channel is choked with *borgou* grass. January 6, 1930.

FIG. 10—The Black Volta at the height of flood, Dédougou-San bridge, looking upstream. November 13, 1929.

Black Volta is undoubtedly deepening by erosion. Determinations of sediments in samples taken at the San bridge carried out in 1929 were as follows in grams per cubic meter: July 31, 34; August 18, 72; September 11, 63; October 4, 12; October 27, 18; giving an average of 40 grams per cubic meter of flow. These determinations do not include heavy sands that may be carried along the bottom. At an assumed average of 40 grams of sediments per cubic meter of water the total flow for the year would carry 60,000 tons of detritus, equivalent to about 45,000 cubic meters of displaced soil. Considering the clean surface drainage of the region, this sedimentary material must come largely from the bed of the stream.

FIG. 11—The confluence of the Sourou (right) and the Black Volta (left) looking upstream. Alluvial island in center. January 8, 1930.

The channel of the Sourou, on the contrary, is slowly silting up with the sediment delivered to it by the Volta. The 170,000,000 cubic meters of water retained by the Sourou in 1929–1930, at the rate of 40 grams per cubic meter yield a deposit of 6800 tons, which is about 5100 cubic meters of soil or a still greater volume of mud. Moreover, the slowly moving waters of the Sourou are filled with aquatic vegetation, the remains of which probably contribute even more considerably to the filling up of the channel. This, in the vicinity of the junction, is already about 1 meter above that of the Black Volta. The Volta channel is free from vegetation, being swept by a comparatively rapid current.

Imminent Capture and Its Prevention

Evidently, therefore, erosion in the bed of the Black Volta and deposition in that of the Sourou will, if preventive measures are not taken, soon complete the capture of the latter stream. Confirming these observations, an old man of Di village, about 50 kilometers north of the Sourou junction, states that when he was a boy (say 50 years ago) the Sourou rose each year to the base of a certain banyan tree. Leveling the top of my camera box with the horizon, no other instrument being available, and sighting across from highwater mark in 1929 to the tree gave an approximate difference in elevation of 1 meter between the two levels. This means that the Volta may have eroded its bed to at least a considerable fraction of this amount in about half a century, with consequently decreasing overflow to the Sourou. At this rate, with a maximum flood-water depth of 4 meters in the Sourou, overflow should cease entirely some two hundred years from now, or sooner, as the sluggish stream becomes choked with vegetation. Inasmuch as the Sourou affords domestic and stock water supplies to an extensive region there is practical interest in the possibility of conservation for these uses as well as for the possible irrigation of considerable areas of lowlands lying along the river.

The return flow of the Sourou to the Black Volta can be prevented by the construction of gates across the stream at any favorable site near the Volta junction. At some points as little as 15 to 18 meters of openings would need to be controlled. Raising the gates from July to late December would admit the overflow; closing them from December to July would retain the water now lost. This construction, however, would become inoperative with the lowering by erosion of the bed of the Black Volta. Permanent conservation would require the construction of a barrage across the Volta below the junction by means of which, for an indefinite time to come, an increased diversion of water to the Sourou could be established. This would necessitate a more expensive structure which, moreover, would have to be maintained against the downstream erosion of a cutting stream.

PREHISTORIC ESKIMO CULTURE ON ST. LAWRENCE ISLAND*

Henry B. Collins, Jr.
United States National Museum

ST. Lawrence Island, the largest in Bering Sea, lies 150 miles below Bering Strait, 100 miles from the Alaskan coast, and 40 miles from Siberia. With a width of 20 miles or less the island extends east and west for about 100 miles, presenting from the sea a view dreary in the extreme—a rugged mountainous interior where snow is visible even in midsummer and a coast line formed either of low-lying tundra or of steep dark-colored cliffs of broken-down granite. The island is largely of volcanic origin, with an occasional symmetrical cone visible in the interior (see Fig. 3). Some of the peaks and plateaus in the central and eastern sections reach a height of 1500 feet or more; at the western end the highest elevations are along the coasts, with intervening stretches of low marshy tundra and numerous lakes and lagoons. For six months or more of the year the island is locked in ice, which does not finally leave its shores until late in June. At the present time the inhabitants, belonging to the Siberian or Yuit group of Eskimos, number some four hundred, the remnants of a much larger population which was greatly reduced by a severe famine and epidemic during the winter of 1878–1879.

Vegetation is of the usual arctic variety, consisting mainly of dwarf willows, mosses, grasses, saxifrages, and other flowering plants. To judge from fossil remains there existed in Tertiary times a markedly different assemblage of plants including sequoia, poplar, sycamore, and alder,[1] evidence of the Tertiary land connection between Asia and America postulated to explain the many and close resemblances between the plant and animal life of the two continents.

From an anthropological standpoint the Bering Strait region is of equal theoretical importance, for it was through this gateway that man also must have entered America. But no trace of these first migrants has yet been discovered around Bering Strait and from present indications may never be, unless through some lucky accident. If man migrated into America during the glacial period any remains that he might have left behind in northern Alaska would now lie deeply buried beneath the frozen muck and ground ice and would

* Published by permission of the Secretary of the Smithsonian Institution.

[1] At Professor Chaney's suggestion the writer in 1930 made a collection of fossil plants. They were found in a coal and shale outcrop on the northern side of the island (Ralph W. Chaney: A Sequoia Forest of Tertiary Age on St. Lawrence Island, *Science*, Vol. 72 (N. S.), 1930, pp. 653–654).

be revealed only through mining operations or in favored localities where fossil-bearing materials become exposed along cliffs and washes. While the bones of mammoths, horses, bison, and other Quaternary mammals have been and are still being found in considerable quantities in Alaska, there has been as yet no reported find of a human bone or authentic artifact of similar age. If man entered America somewhat later, after the last ice invasion, the chances of his remains being found in the far north are also slight; for, assuming that he would have penetrated the interior along present watercourses, all traces of such passing or of very early settlements would long since have been destroyed through the constant sloughing of the river banks.

While the discovery of definite evidences of early man in the Bering Strait region is something that the future may possibly bring, the immediate anthropological problem is that of the origin of the Eskimos. Investigations in Alaska during the past five summers have been specifically directed towards its solution; and, while they have thrown no light on original migrations and produced no evidence of a pre-Eskimo population, they have pushed that origin far back into the past and necessitated a reëxamination of all of the relative evidence.

The Investigations

The first systematic excavations in Alaska north of the Aleutian Islands were those made by Mr. Diamond Jenness at Bering Strait in the summer of 1926.[2] At Cape Prince of Wales and Little Diomede Island he found traces of an earlier Eskimo culture characterized especially by an art style much more elaborate than any now existing in the Arctic or sub-Arctic regions. The designs, engraved only on deeply patinated artifacts of walrus ivory, consisted of a graceful combination of curving lines, circles, and ellipses, in contrast to the much simpler straight line and circle ornamentation of the present Eskimos. The Bering Sea culture, as Jenness named it,[3] appeared to be more ancient than the extinct Thule culture of the Hudson Bay region and Greenland; and, as this was the oldest culture in the eastern Eskimo area with which it could be directly compared, it thus became the most ancient Eskimo culture known.

In the same year, 1926, Dr. Aleš Hrdlička made an anthropological survey of the Alaskan coast from Norton Sound to Point Barrow and was able to obtain at St. Lawrence Island a number of similarly decorated artifacts of the Old Bering Sea culture from the Eskimos

[2] Diamond Jenness: Ethnological Problems of Arctic America, in "Problems of Polar Research," *Amer. Geogr. Soc. Special Publ. No. 7*, New York, 1928, pp. 167–175.

Idem: Little Diomede Island, Bering Strait, *Geogr. Rev.*, Vol. 19, 1929, pp. 78–86.

[3] Diamond Jenness: Archeological Investigations in Bering Strait, *Natl. Museum of Canada Bull. No. 50 (Ann. Rept. for 1926)*, Ottawa, 1928, pp. 71–81.

It is called here the Old Bering Sea culture, to distinguish it from a later transitional phase.

who had excavated them from old sites on the island.[4] As a result of Dr. Hrdlička's investigations I was detailed by the Smithsonian Institution to conduct anthropological work in Alaska the following year. With Mr. T. Dale Stewart I examined parts of the coast from Bristol Bay to the mouth of the Yukon, spending the greater part of the time on Nunivak Island. During the three succeeding summers, 1928–1930, the work was continued, and I made excavations at a number of sites from Norton Sound northward to Point Hope.[5]

No traces of the Old Bering Sea culture were found in Norton Sound or to the southward; but on St. Lawrence Island, where beginning with 1928 the greater amount of work was done, I was fortunate in finding abandoned villages whose middens yielded a large quantity of material. This has not only thrown light on the Old Bering Sea culture itself but has made it possible to trace from this period successive stages through which Eskimo culture on the island has passed.

In 1928 and 1929 the excavations in this area were confined to two large abandoned villages, one on Punuk Island, four miles off the eastern end of St. Lawrence, and the other at Cape Kialegak, near Southeast Cape. In 1930, excavations whose results are briefly outlined in the following pages were carried on for four months at Gambell. Gambell, the largest settlement on St. Lawrence Island, is situated at its northwestern extremity, forty miles from the Siberian coast. The 200 inhabitants live during the winter in dome-shaped, skin-covered houses, a Chukchi type adopted in comparatively recent times. The summer dwelling is a smaller and simpler structure of skins. In recent years, however, the skin summer dwellings have been largely replaced by houses of wood.

The Abandoned Villages and the Finds

The present village of Gambell is at the end of a gravel spit about half a mile wide which extends for three quarters of a mile westward from the base of Gambell Mountain, Cape Chibukak (Sevuokuk) (see Figs. 1 and 2). On the spit are also three abandoned villages, known to the Eskimos as Miyowaghameet, Ievoghiyogameet, and Seklo-

[4] Aleš Hrdlička: Anthropological Work in Alaska, *Explorations and Field-Work of the Smithsonian Instn. in 1926* (*Publ. 2912*), pp. 137–158, Washington, 1927.

Idem: Anthropological Survey in Alaska, *46th Ann. Rept. Bur. of Amer. Ethnology for 1928–1929*, Washington, 1930, pp. 19–374.

[5] Henry B. Collins, Jr.: The Ancient Eskimo Culture of Northwestern Alaska, *Explorations and Field-Work of the Smithsonian Instn. in 1928* (*Publ. 3011*), Washington, 1929, pp. 141–150; *idem:* Prehistoric Art of the Alaskan Eskimo, *Smithsonian Misc. Colls.*, Vol. 81, No. 14, Washington, 1929, pp. 1–52; *idem:* Prehistoric Eskimo Culture of Alaska, *Explorations and Field-Work of the Smithsonian Instn. in 1929* (*Publ. 3060*), Washington, 1930, pp. 147–156; *idem:* Ancient Culture of St. Lawrence Island, Alaska, *Explorations and Field-Work of the Smithsonian Instn. in 1930* (*Publ. 3111*), Washington, 1931, pp. 135–144.

I wish to thank Captain E. D. Jones of the U. S. Coast Guard Cutter *Northland* for his very valuable assistance; and likewise my assistants during the past three summers, Messrs. Harry E. Manca, G. Herman Brandt, and James A. Ford.

waghyaget, and, adjoining the present village, the house pits and refuse of old underground houses abandoned for the most part within the past century.

Beginning at the base of the mountain and extending westward to the village at the end of the spit is a series of parallel ridges of gravel—old beach lines—which from the top of the mountain can be seen very distinctly. The position of the several old villages in relation to these former beach lines and to the present beach affords some evidence of their respective antiquity, for villages of the maritime Eskimo are always situated close by the sea or other body of water. The ruins closest to the present village at the end of the spit should be the latest; these are the recently abandoned houses *A* (see Fig. 1) and the adjoining old site Seklowaghyaget *B*. In the same way the oldest of the abandoned villages should be Miyowaghameet, *D*, at the base of the mountain three-fourths of a mile and half a mile distant from the sea and enclosed in the first two (the oldest) beach lines. Ievoghiyogameet, *C*, some 200 yards north of *D*, is separated from it by four beach lines and thus should date from a somewhat later period. Between *C* and the north shore are six more old beach lines, most of which were no doubt piled up after the abandonment of the village.

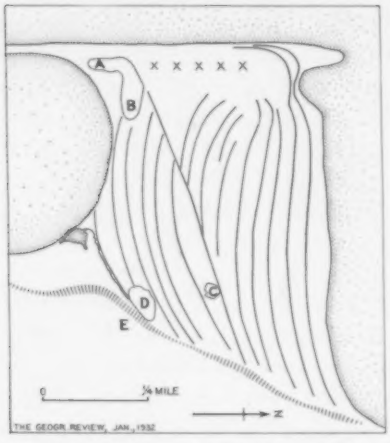


FIG. 1—Map of the gravel spit at Gambell, showing the location of the old villages, *A–D*, in relation to the former beach lines, indicated by the curving parallel lines. The present village is marked by crosses; *A* is the most recently abandoned village; *B*, Seklowaghyaget; *C*, Ievoghiyogameet; *D*, Miyowaghameet; *E*, the oldest site, on the lower slope of the mountain.

The archeological evidence resulting from four months of intensive excavation bore out this assumed sequence, although some doubt remains as to the exact chronological position of *B*. This old village may have been established during the occupancy or shortly after the abandonment of *D*, even though it certainly continued to be occupied for many years after the abandonment not only of *D* but also of *C*. A fifth site, *E*, unknown to the Eskimos and completely covered over with sod, moss, and rocks, was found on the lower slope of the mountain.

The most recent material excavated at Gambell was from a rectangular semi-subterranean house abandoned probably forty years ago. The objects in it, which included quantities of iron, were modern in every respect. A cut in the refuse of this same section, immediately

FIG. 2—Lake and gravel spit with old beach lines at Gambell, looking westward from top of Cape Chibukak (Sevuokuk). At left center is the grass-covered midden of Ievoghiyogameet, one of the abandoned villages. The present village is at the far end of the spit.

to the south of the present village, yielded material slightly older, as was shown by a difference in harpoon heads (Fig. 4, 38–40) and a relative paucity of metal and glass beads. Most of the decorated objects from this cut were of the modern art, but there was also included a single example of Punuk art, a style that I had found in 1928 and 1929 to be characteristic of the old sites at Punuk and Cape Kialegak and which represents a transitional stage between the Old Bering Sea art and the modern. Punuk art is characterized by deeply and evenly incised lines, straight or slightly curving, together with dots, spurs, and nucleated circles (Fig. 6). While the Punuk art is more graceful than modern Eskimo art, it nevertheless bears a closer resemblance to it than to the Old Bering Sea art. The circles, for instance, are always perfectly round and were produced apparently with a metal bit. During the Old Bering Sea period, on the contrary, the circles were all made free-hand and were slightly irregular, while the lines were usually more lightly incised except where deepened for contrast (see Fig. 5).

B was the largest of the old villages in area, and the midden had an average depth of four to five feet. In the upper levels were found additional examples of late prehistoric types of harpoon heads that had occurred at *A*, the most recently abandoned site (Fig. 4, 33–37). Lower down in the midden of *B*, however, these two types were replaced by other harpoon heads (Fig. 4, 31–32). Decorated objects excavated at *B* were all in the Punuk style.

C proved to be another pure site of the period represented by Punuk art. The midden reached a depth of five feet and was richer in material than *B*. The prevailing forms of harpoon heads (Fig. 4, 24–25) were the same as those from the lower levels of *B*, but other types (26–30) were present, including a

FIG. 3—Near Cape Kialegak at the southeastern end of St. Lawrence Island. Looking across the top of a plateau strewn with granite blocks to a small peak at the center and, beyond, a wide stretch of low marshy tundra intersected by small streams, lakes, and lagoons.

modification of the Birnirk harpoon head, a form typical of the old sites around Point Barrow (Fig. 4, 26).

At *D*, the old site at the foot of the mountain, there was evidence of important cultural modifications. The midden was from five to eight feet deep and like *C* it was rich in artifacts of ivory, bone, stone, baleen, pottery, and wood. At the northern and extreme western sections of the midden down to within about a foot of the bottom, it yielded harpoon heads (Fig. 4, 19–23) similar to those from *C* and also examples of the original Birnirk type (Fig. 4, 18). The decorated objects from this later section of *D* were of especial interest. None bore the very deep lines nor the perfect circles that are among the characteristic features of Punuk art and which had been so typical of *C;* but, instead, the lines, dots, and spurs were lightly incised even though the composition followed the usual Punuk patterns (Fig. 4, 15–17, 19–23). This was a style of decoration that I had found previously to occur at an average greater depth in the Punuk and Kialegak middens than any other (with the exception of the very few Old Bering Sea pieces found at those places). In view of its position at Gambell, it now seems permissible to refer to this style as early Punuk. Its position was further made clear by finding Old Bering Sea art beneath it, at the base of the midden. At the opposite or eastern and southern sections of *D* the proportion of Old Bering Sea and Punuk art was reversed; early Punuk decoration occurred only in the surface layers, below which Old Bering Sea art was found exclusively. In Fig. 4, 6–14, are shown typical harpoon heads from this older section of *D;* decoration, when present, was Old Bering Sea, and there was a marked tendency toward an elaboration of the base.

On the lower slope of the mountain and immediately back of *D* we found almost by accident a buried site, *E*, the decorated objects of which from top to bottom—29 in number—were all of the Old Bering Sea style. The presence of an old village at this spot was not suspected by the Eskimos, although the trail to the mountain top which they and their ancestors had followed for generations passed directly over it. The harpoon heads from this oldest village, *E* (shown in Fig. 4, 1–5), were in the main similar to those from the adjoining oldest section of *D*, although certain minor differences were observed. The art also, while unmistakably Old Bering Sea, was of a different stamp, being more generalized and less perfectly executed than that from *D*. At the latter place a standardization had begun, which by selection and elaboration of existing designs had resulted in the highest accomplishment of Eskimo art.

Aside from harpoon heads and art there seems to have been no great distinction between the common implements of the Old Bering Sea period (as revealed at the pure site *E*) and those of the succeeding

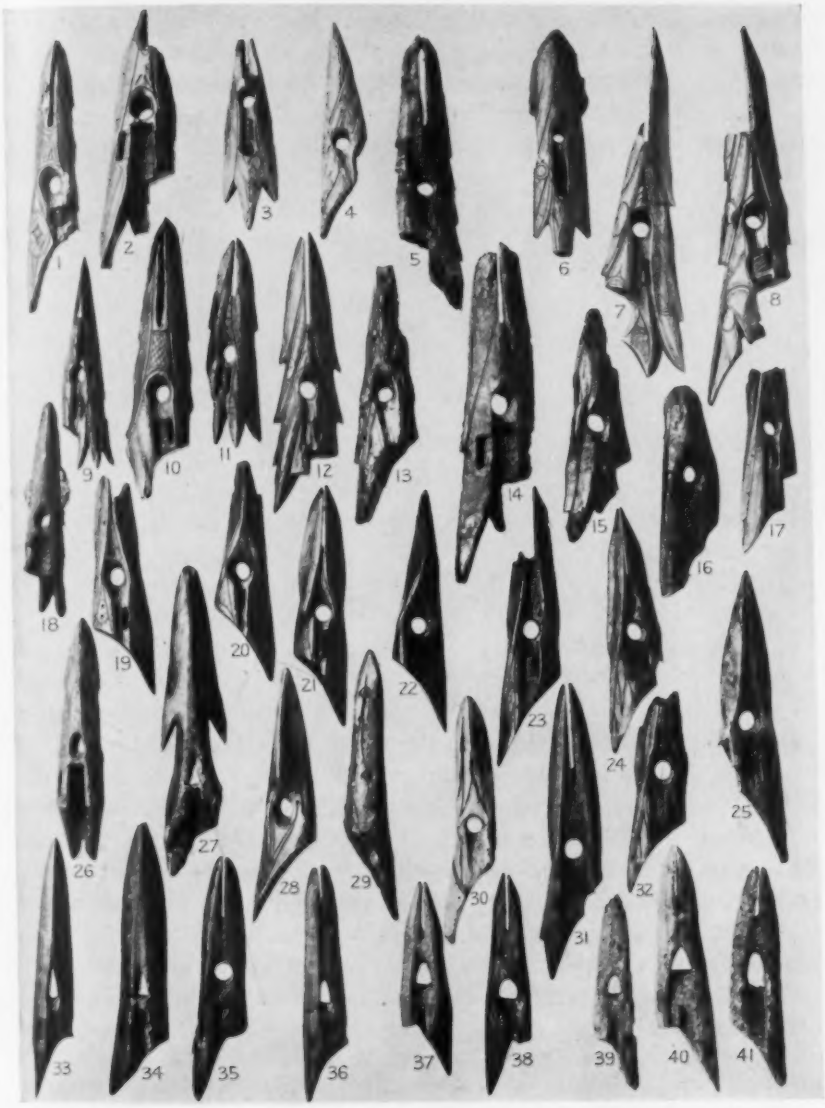


FIG. 4—Harpoon heads from the five old sites at Gambell, with the oldest shown at the top and the most recent at the bottom. 1–5, from the buried hillside village (*E*), Old Bering Sea period; 6–23, from Miyowaghameet (*D*) (6–13 decorated in Old Bering Sea style, 15–17 and 19–23 in early Punuk); 24–30, from Ievoghiyogameet (*C*), where decoration was all of Punuk art; 31–37, from Seklowaghyaget (*B*); 38–40, from most recently abandoned village (*A*); 41, modern type, from house abandoned about forty years ago. About one-third natural size.

Punuk period. The chief differences observed were in stone implements, the Old Bering Sea culture being characterized by an abundance of small flint tools of irregular shape, most of them merely flakes with finely rechipped edges; along with these were chipped as well as ground slate blades, for knives and harpoons, and rubbing stones with five

smoothed surfaces. Another distinction was the smaller amount of baleen at the old hillside site. Whale bones were also scarce, although walrus and seal bones occurred in abundance, from which it would appear that whaling had a far less prominent place in the economy of these earliest St. Lawrence Eskimos than it came to have later.

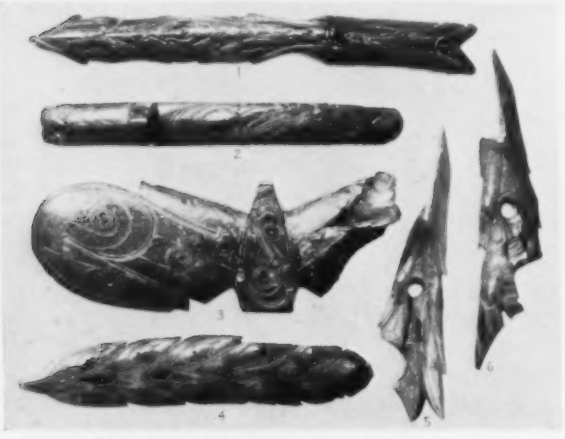


FIG. 5—Examples of Old Bering Sea art from Miyowaghameet (*D*). 1, intestine scraper (?); 2, handle of pail; 3, use unknown; 4, pail handle (?); 5, 6, harpoon heads. About one-third natural size.

THE HOUSE TYPES

The excavations at Gambell showed, although imperfectly, the house types of the different periods. Ten ruined houses were excavated, one or more at each of the sites. The cultural changes outlined above were correlated to some degree with changes in house construction. The houses of the Old Bering Sea period, found at *E* and *D*, were small, semi-subterranean, square or rectangular structures with stone floors but no sleeping platforms and with walls of horizontally laid small timbers held in place by wood and bone stakes; there was a long narrow entrance passage with stone floor and walls and timbered roof, with the floor at a slightly lower level than that of the house. A modification of this type came into use during the early stages of the succeeding Punuk period; it was similar in all essential respects but was almost twice as large and had a roof of small driftwood timbers.

Later in the Punuk period there appeared a different type of house, semi-subterranean, square to rectangular, with stone floor but with walls of stones, whale bones, and walrus skulls instead of horizontal timbers; no sleeping platforms; entrance passage narrow and roofed with whale ribs or large stones. There was usually a circular enlargement or annex to the passage, used probably for cooking and storage purposes. A modification of this form, with walls entirely of stones and lacking an entrance passage was used apparently as a summer dwelling.

The third and last prehistoric house type, belonging also to the Punuk period but continuing in use up to forty years ago, differed in certain fundamental features from the preceding forms. It was

semi-subterranean, square to rectangular, with floor of neatly fitted hewed planks or logs and walls of small timbers and whale jaws placed on end and leaning slightly inward; low sleeping platforms along two or three sides; two to six heavy uprights rising from the floor supporting two or three large whale jaws which served as roof beams.

Skeletal Remains

Although careful search has been made for early burials at the rock cemeteries of all the old villages investigated on St. Lawrence Island, these have yielded no bones older than a few hundred years. However, well preserved skeletal remains from the frozen middens and old houses of the Punuk period have been found, although in no great number. From these it is seen that the Eskimos of that period were mesocephalic like the present St. Lawrence population. Unfortunately the excavations at the oldest sites have yielded very little skeletal material—only two skeletons and a detached skull found in and near a house of the Old Bering Sea period at *D*. One of the skulls was mesocephalic, two were extremely dolichocephalic, falling in this respect beyond the range of normal variation for modern St. Lawrence crania. While it would not be proper to draw any far-reaching conclusions on the basis of these two skulls alone, they represent nevertheless the most ancient Eskimo skeletal remains that have yet been found, and the fact that they are markedly long-headed is something to be considered by any theory which seeks to trace the origin and spread of the Eskimo on the basis of physical characters.

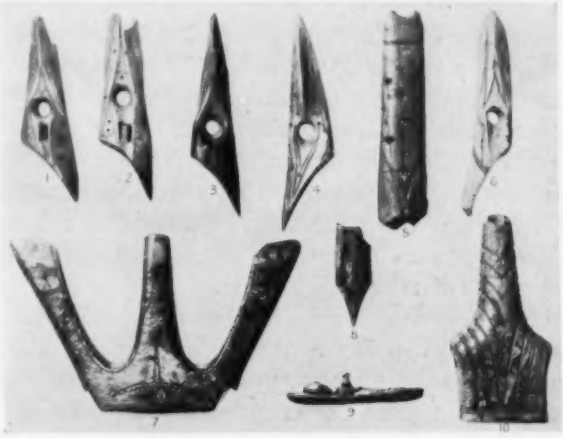


Fig. 6—Objects decorated in Punuk style from three old villages at Gambell. 1–3, harpoon heads, Miyowaghameet (*D*); 4, 6, 8, harpoon heads and fragment, Ievoghiyogameet (*C*); 5, use unknown, Ievoghiyogameet; 9, man in kayak, Ievoghiyogameet; 7, 10, from Seklowaghyaget (*B*), use unknown. About one-third natural size.

Relationships of the Old Bering Sea Culture

The several thousand specimens excavated from the five abandoned village sites at Gambell afford sufficient evidence to establish a tentative chronology for Eskimo culture on St. Lawrence Island begin-

ning with a rather early stage of the Old Bering Sea culture and extending up to the present time. The chronology is based on: (1) stratigraphy, or the superposition of types in the middens; (2) the positions of the several old villages in relation to former beach lines and the present beach; (3) a series of changes in art technique and harpoon heads consistent with the interpretations implied by 1 and 2. The final chronology must of course be based on a study of all of the implement types, but nevertheless harpoon heads and art must bear the main weight of it;[6] for, while some changes and replacements in other implements did occur, there was nothing comparable to the long series of changes which, beginning with the elaborate art style and complicated harpoon heads of the Old Bering Sea period, resulted finally in the very simple forms of these features at the latest ruins.

An important point to be determined is to what extent the St. Lawrence chronology will fit archeological conditions elsewhere in northern Alaska and Siberia. According to our present knowledge the Old Bering Sea culture extended northward from St. Lawrence Island through Bering Strait, up to Point Barrow, and possibly for a considerable distance westward from the Strait along the Siberian coast, for typical harpoon heads have been found as far west as the Kolyma River. Within these wide limits cultural changes would doubtless to a certain extent proceed unevenly, some of the representative groups having a more rapid and others a slower development, while here and there local traits would probably arise and become established. The question of local development is specially important in the case of such an area as St. Lawrence Island, because of its peripheral location and partial isolation. According to present indications, however, the Old Bering Sea culture seems to have followed the same general course here as elsewhere in northern Alaska, for the material thus far known from other Old Bering Sea sites is duplicated on St. Lawrence. But such a uniformity seems not to have continued, for in the Punuk stage we find certain implements that appear to be local developments on St. Lawrence, although the Punuk style of art itself is not purely local, having been found also at the Diomedes and Point Hope. Finally, we have abundant evidence of a radical change which in late prehistoric times brought the St. Lawrence Island Eskimos to their present state of cultural isolation from the Alaskan Eskimos. This was within the past several hundred years, when the culture of the island was practically replaced by a late migration or migrations of Siberian Eskimos who had already been strongly modified by the Chukchi.

[6] This condition in regard to harpoon heads has been noted by Jenness (*op. cit.*) in describing his finds at Cape Prince of Wales and Diomede Island and by Mason in describing material excavated in the vicinity of Point Barrow. See J. Alden Mason: Excavations of Eskimo Thule Culture Sites at Point Barrow, Alaska, *Proc. 23rd Internatl. Congr. of Americanists Held at New York, Sept. 17–22, 1928*, New York, 1930, pp. 383–394.

Age of the Sites

While the chronological positions of the old sites one to another are clearly revealed by the excavations at Gambell, there seems to be as yet no reliable means of determining their actual age. Sections of timbers from each of the villages were saved for study, but it seems somewhat doubtful whether the tree-ring method of chronological determination can be applied successfully to Arctic driftwood.

The old beach lines show the manner in which the gravel spit was built up and might afford a basis for a chronology, but no interpretation in terms of years seems possible until more is known of the rate of formation of such shore deposits in northern latitudes. A third possible means of dating the sites, or at least of giving a maximum age for some of them, might be found in historical associations with the Orient, for it is quite likely that long before the seventeenth century there had been at least sporadic and indirect contacts between the Eskimos around Bering Strait, on both the Siberian and Alaskan sides, and the more highly advanced peoples of eastern Asia. Laufer mentions an early Chinese reference to the fossil mammoths of Arctic Siberia contained in an account ascribed to the Han Dynasty (140–87 B. C.) and also records evidence showing that walrus ivory was known to the Chinese at least as early as the seventh century A. D. and that it formed part of the tribute sent to China by tribes having contact with Kamchatka.[7] Of still greater interest is Laufer's statement that in A. D. 262 the Su-chen, a tribe dwelling beyond the boundaries of Korea but whose northern limits were unknown, sent to China a tribute consisting of bows, arrows, crossbows, sables, and suits of armor made of leather, bone, and iron.[8] The Su-chen possessed on the whole a stone age culture and were probably in contact with other northeastern Asiatic tribes of similar status such as the Koryak and Chukchi. As the most likely source of the iron possessed by the Su-chen, Laufer mentions the interior of Siberia, which from ancient times had been a center of iron working, and Korea where in later times, about the beginning of the Christian era, an iron industry arose. If iron was in the possession of this northeastern Asiatic tribe at this early date, it was in all probability also known and used to some extent by the Koryak and Chukchi, in which case it would almost certainly have been passed along to their neighbors the Siberian Eskimos.

Archeological evidence seems clearly to indicate that metal reached St. Lawrence Island long before the seventeenth or eighteenth centuries when Russian trade goods were received through the Chukchi; for the Punuk art with its deeply and evenly incised lines and mechani-

[7] Berthold Laufer: Ivory in China, *Field Museum of Nat. Hist. Anthropol. Leaflet 21*, Chicago, 1925, pp. 24–25 and 53–54.

[8] *Idem:* Chinese Clay Figures, *Field Museum of Nat. Hist. Publ. 177 (Anthropol. Ser., Vol. 13, No. 2)*, Chicago, 1914, pp. 262 *et seq.*

cally perfect circles could have been produced by none other than metal tools. Ruined villages dating from as late a period as the seventeenth or eighteenth centuries are easily recognized not only by the actual presence of iron but also by glass beads and certain characteristic late types of artifacts. Punuk art seems to have survived to about the beginning of this time, but it arose much earlier; as is shown by the series of old sites at Gambell and by the huge middens elsewhere, such as the 16-foot accumulation on Punuk Island, which contained Punuk art from top to bottom even though there was every indication that the site had been abandoned at least 200 years. In view of the historical references given by Laufer we may recognize the possibility that small quantities of Asiatic metal could have been in use on St. Lawrence Island sixteen hundred years ago, but there seems no way to arrive at a closer approximation of the date; and beyond that the uncertainties increase.

Cultural Diffusion as Age Criterion

One fact clearly brought out by recent archeological work in Alaska is the inadequacy, for this region, of the method that seeks to determine the age of a culture strictly on the basis of the geographical distribution and the simplicity or complexity of its traits, the assumption being that those groups are oldest whose traits are simplest and most widely distributed. The habits of the Eskimos and geographical conditions in the Arctic are such as to make possible a more than ordinary rapidity and frequency of cultural diffusion, thus offering even greater difficulties than those naturally inherent in any application of the theory. With conditions favorable to unrestricted eastward and westward movements along the coasts, there is no reason why, with improved means of transportation, a late migration should not have brought about a wide diffusion of late traits and the superposition of these over other traits that were older but less widely distributed. There is in addition a serious and particular objection to distribution as a criterion for determining the relative ages of archeological types in that the oldest types are likely to be the most deeply buried and thus less frequently found, while the later ones may be readily found at the surface over a wide area. This objection applies particularly to the Eskimo area where archeological conditions are as yet so little known. Nor can simplicity of form be used indiscriminately as an indication of age, for it is obvious that there must first be evidence that the simplicity in question represents an original or early condition and is not the result of degeneration. Mathiassen follows this method in attempting to determine the age of the Thule culture in Alaska principally on the basis of collections obtained from the Eskimos at East Cape, Point Hope, Point Barrow, Barter Island,

and Point Atkinson. Mainly because of the wide distribution, from northeastern Siberia to Greenland, of the Thule elements occurring in these collections, he considers that the Thule culture is very ancient in Alaska; that on the Arctic coast it is even older than the Old Bering Sea culture; and that the Thule harpoon heads are the simple forms from which the Birnirk type of northern Alaska developed.[9] Stratigraphy fails to bear out these assumptions. At the oldest village at Gambell—the buried hillside site *E*—there were found harpoon heads of Old Bering Sea type with side blades and divided spurs, both features characteristic of the Birnirk heads; and the same features occurred at the next oldest village, where true Birnirk heads were also found. Thule types, on the other hand, were found only at the three latest sites. This is in keeping with a condition that has been found in northern Alaska wherever stratigraphic work has been carried on. Jenness detected a Thule stage at Bering Strait later than the Old Bering Sea, while the conditions I found in 1928 and 1929 at Punuk Island and Cape Kialegak led to a similar conclusion.

The Thule culture undoubtedly had its origin in Alaska, as Mathiassen has shown;[10] but just when and where it is too early to say. The origin of the Old Bering Sea culture is more obscure, although the scanty evidence at present available would seem to point toward northeastern Siberia, somewhere between the Anadyr and Kolyma rivers, as the region where this rich old Eskimo culture evolved.

[9] Therkel Mathiassen: Some Specimens from the Bering Sea Culture, *Indian Notes* (Museum of the Amer. Indian, Heye Foundation, New York), Vol. 6, 1929, pp. 33–56.

Idem: Archaeological Collections from the Western Eskimos (Rept. of the Fifth Thule Expedition 1921–24, Vol. 10, No. 1) Copenhagen, 1930.

[10] *Idem:* Archaeology of the Central Eskimos (*ibid.*, Vol. 4), 2 vols., Copenhagen, 1927.

GEOGRAPHICAL TRENDS IN SUGAR PRODUCTION

C. J. Robertson

International Institute of Agriculture, Rome

THE world trade in sugar presents the interesting feature of bringing into direct competition agricultural production of tropical and temperate zones, an identical product being obtained from two widely different plants under two very diverse sets of geographical conditions. In this production political factors have long played a particularly important part. The production of sugar has been a peculiarly widespread national ambition from the origins of the modern cane-sugar industry under the old mercantilist colonial systems and those of the beet-sugar industry in the earlier part of the nineteenth century to the present day, when it is calculated that three-quarters of the world's output receives some protection or preference.[1] In the following paper inquiry will be made into the extent to which the political factor counteracts the tendencies to a regional distribution of sugar production determined by non-political factors.

From the middle of the nineteenth century to 1913–1914 the average rate of increase of sugar production was 3.5 per cent per annum, so that world production doubled every twenty years. It was not till the latter half of the century that the rapid growth in importance of beets as a source of sugar supply had begun, but by the end of the century beet sugar made up 64 per cent of the total, declining, however, to 48 per cent in the period 1909–1910 to 1913–1914. The average of world production in the five pre-war years was 17.5 million metric tons, British India and Germany leading with 2.3 million each. Cuba, which produced 2 million tons, and Russia, which produced 1.7 million, were both increasing production at a rate greater than that of the world total; and the two leading producers were tending to fall behind.

The war brought a great decline in European production, whether through military operations over the beet areas themselves or through its reactions on the national economy of the belligerents; and in 1919–1920 beet sugar made up only 21 per cent of world production, its lowest relative position for sixty years. The absolute decline in European production, coincident with the revival of consumption

[1] Memorandum on Sugar, *League of Nations Publs., Economic and Financial Section*, II, 20, Geneva, 1929, p. 31.

after the war, was the stimulus to a great advance in cane-sugar production. This post-war boom collapsed in 1920. New cane plantations coming into full production coincidently with the revival of European beet-sugar production not only restored the upward trend of world production after 1919–1920 but led to overproduction and the accumulation of stocks, with consequent depression of prices, which reached the lowest level ever recorded (1.03 cents per lb., c. and f., Cuban raw sugar at New York) at the end of September, 1930. Attempts, in which the initiative had for some time been taken by Cuban interests, with their large dependence on unprotected markets, to bring about an international agreement for the control of production and export received a fresh stimulus and eventually culminated in the Brussels Sugar Convention of 1931.

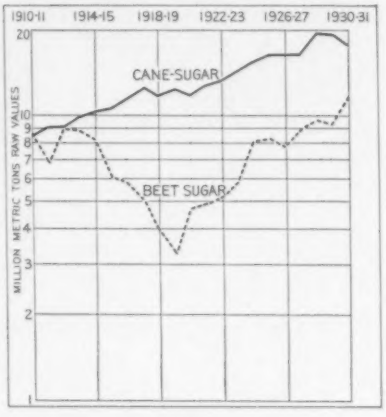


FIG. 1—The world's production of cane sugar and beet sugar compared.

THE POSITION OF CUBA

Comparison of the logarithmic diagrams shows clearly how much more rapid has been the upward movement in Cuban production than in that of other sections of the sugar industry or in that of total world production. Cuba is now the leading producer and exporter, accounting in the period 1925–1926 to 1929–1930 for 18 per cent of the world production and in 1925–1929 for 34 per cent of the world export. The rapid development of its sugar industry dates from 1902–1903 when it recovered from revolution and the war of independence. Production, which even before the war had increased more rapidly than the world total, grew with little interruption to more than 2.6 million tons in 1913–1914; in 1918–1919 it was 4.1 million and attained 5.2 million in 1924–1925 and again in 1928–1929, when the restriction policy of the intervening years had been abandoned. The average production in the period 1925–1926 to 1929–1930 was 4.7 million tons as compared with 2 million in the period 1909–1910 to 1913–1914—an increase of 135 per cent, the world total having increased in the same period by only 52 per cent.

With a favorable climate and, more especially, highly suitable soils and an abundance of quite unused and of young lands, Cuba was also favored by its proximity to the United States, a vast and growing market with one of the highest per capita rates of sugar consumption

in the world. In the period 1909–1910 to 1913–1914 the United States took 92 per cent of the island's total export of raw sugar. Under the reciprocity treaty of 1902 Cuba received a 20 per cent preference in the United States, most of which in the earlier years was actually obtained by the Cuban producers, with a consequence that North American capital flowed into the island, modernizing the mills and transport system and permitting economies of large-scale production to an unprecedented degree. Cuban agriculturists responded to the rapidly growing demand of the mills by extensive methods, producing cheap cane with little preparation and still less cultivation of the land, rarely using fertilizers and clearing fresh areas of rich virgin soil to replace the exhausted lands.

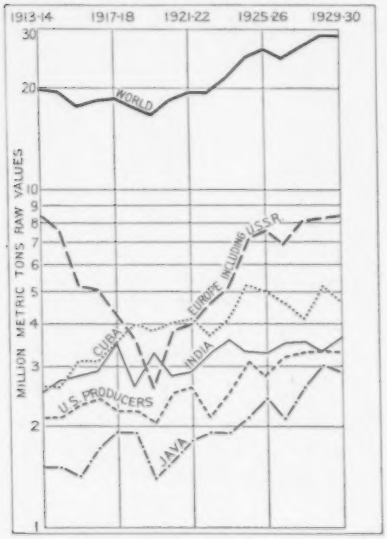


FIG. 2—Sugar production of the world as a whole and leading producers.

Cuba was thus enabled to take the lead in meeting the sharp rise in demand when sugar was generally decontrolled in the years immediately following the war, and the same factors helped the situation in the years of depression that have followed the reaction in 1920, particularly in the face of less favorable conditions in the United States market. The weakening of this last crucial factor, the island's favorable situation with reference to the United States market, may be regarded as the fundamental stimulus to Cuba's efforts to secure international agreement in the industry. At the same time the deterioration of Cuba's position in its main market owing to protective encouragement of United States producers is a striking instance of the important part played by political factors. It is generally recognized that none of the United States producers could survive without the tariff.[2]

As regards the future trend of Cuban production even the land at present under cane is estimated to be sufficient to produce 6 million tons of sugar. Cuba is faced with the alternative of continuing its extensive methods of cane agriculture and even expanding its cane area when need arises or of concentrating its capital resources on a smaller area, selecting the lands most suited to cane, introducing fertilizers, economizing labor by introducing machinery, to which

[2] Compare J. W. F. Rowe: Studies in the Artificial Control of Raw Material Supplies, No. 7. Sugar, *Royal Econ. Soc., Memo. No. 23*, London, 1930, Part I: The Sugar Industry of Cuba.

its topography is adapted, controlling cane diseases, and devoting more attention to research generally. The latter policy would, by limiting and even lowering the area under cane, automatically give opportunity for the diversification of agriculture that has often been recommended as a wise course for the island.

The Contrasted Situation in Java

The tempo of development has been considerably less rapid in Java than in Cuba. Production rose from 1.3 million tons in the period 1909–1910 to 1913–1914 to 2.5 million in the period 1925–1926 to 1929–1930, an increase of 92 per cent. As an exporter of sugar Java has attained a position second only to that of Cuba, thanks to a set of internal and external geographical conditions in notable contrast to those of the latter island. The great density of the population, while causing the Government to restrict the area annually under cane and preventing the practice of ratooning, has, on the other hand, given the industry its greatest internal advantage in competition, namely cheapness of labor. Correlatively cane-growing in the island is carried on by intensive methods. Only the better soils are used, fertilizers are applied, and 90 per cent of the area is irrigated by painstaking methods, while the results of scientific cane-breeding and other agricultural research are put into practice to an extent unrivaled in other cane-growing countries. The results are unit yields of cane and sugar two to three times as high as in Cuba, while costs of production are generally agreed to be the lowest in existence.

Like Cuba, Java has a great external advantage in its location with respect to a great market. Since 1902 Java has relied mainly on markets east of Suez, disposing of its direct-consumption sugars chiefly in British India and the Far East. Unlike Cuba it receives no preferential treatment but relies on a skillful sales policy.[3] Thus Java faced the crisis with a backing quite contrary to and naturally much stronger than that of Cuba, and this was the reason for its relative reluctance to become a party to an international agreement. Its independence from the direct action of political factors is unique in the sugar world.

United States Producers

Production in United States territories has since 1913–1914 grown at roughly the same rate as that in Java. The trends of domestic beet production and of Hawaiian and Porto Rican cane have been roughly parallel to the general trend; that of Philippine production has been steeply upward; and that of Louisiana production, at any rate until 1926–1927, about as steeply downward.

[3] Rowe, *op. cit.*, Part II: The Marketing of Java Sugar.

The United States sugar producers, insular or continental, owe their rise and continued existence to the tariff. United States beet-sugar production is much more dependent on this protection than is European production since it does not have the peculiar complex of labor conditions and the strong position in the crop rotation or, in several districts, the association with the livestock industry that give to the crop in Europe a certain independent power of resistance to adverse conditions. Given protection, further expansion is not, however, hindered by any lack of suitable soil areas.

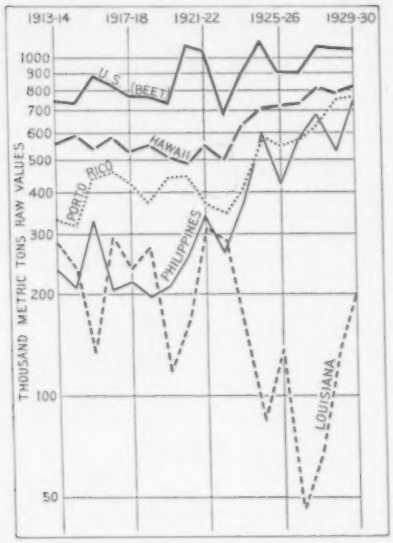


FIG. 3—Sugar production in United States territories. According to the latest estimates of the International Institute of Agriculture the figures for 1929–30 are revised thus (metric tons): Louisiana, 181,000; Porto Rico, 785,000; United States beet, 993,000; Philippines, 810,000.

Production in Hawaii, stimulated by free access to the United States market, rose steadily till 1915 and again more rapidly after 1922–1923. Hawaii, like Java, has favorable soil conditions and highly developed research and marketing facilities but, in addition to heavy expenses for irrigation and fertilizers, lacks the abundant cheap labor. And, because area is limited and diversification necessary, intensive exploitation, though already brought to a high pitch, must continue the main line for further development.

Porto Rico, though enjoying a highly developed plantation system, obtains its results at relatively high cost in fertilizers and in other respects, so that here, as in Hawaii, there is a powerful check to upward movement.

The Philippines, though showing a steady upward trend from the 1902 minimum, have done little more than regain the 1895 level. A falling off in the rate of expansion is noticeable after 1924–1925. In fact there has been little increase in area. Expansion in production is due to modernization of the milling side, the agricultural methods of the small farmers, who produce a great part of the cane, being very backward. Even if the potential cane area is as large as is sometimes assumed, soil and climatic advantages are offset by scarcity of labor and of capital.

Louisiana, while possessing good soils, is distinctly marginal climatically owing to the comparatively short frost-free period and not only suffers from low sugar content due to immature cutting

but from mosaic disease and borer and, until recently, from very marked degeneration of its cane varieties. Since 1926–1927, when production had declined even below the level of the forties, the introduction of new varieties has brought about a revival. The labor difficulty is another limiting factor overcome only by the tariff protection.

India and Other Producers in the British Empire

British India, though second only to Cuba as a producer and possessing a cane area equal to half the world's total, does not supply enough to satisfy the needs of its vast population. Production remains relatively stable, allowing for variation due to climatic causes, at a level that is low relative to the vast area under the crop. Agricultural methods are inefficient; and an unfavorable climate, making irrigation necessary, plays its part. In the general absence of fertilizers soil fertility has become stabilized at the low level maintained by the processes of natural recuperation. Almost the entire production of sugar is in the form of *gur*, solidified cane juice without much purification. The main source of white sugar is Java. In India the upward trend of sugar production as a whole is likely to be slow, so immense are the obstacles to agricultural progress.

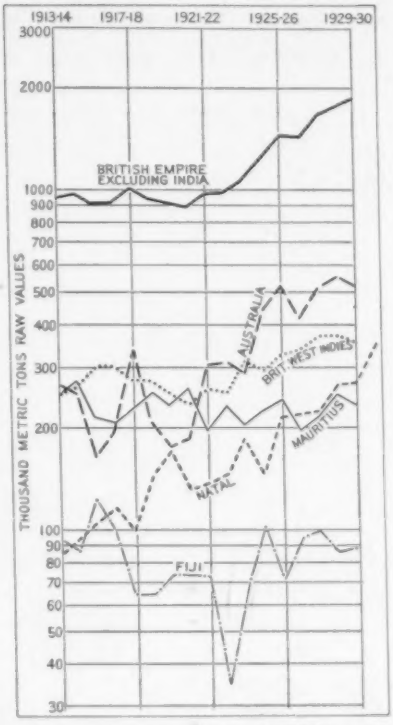


Fig. 4—Sugar production in British territories. According to the latest estimates of the International Institute of Agriculture the figure for Australia for 1929–30 is 539,000 metric tons. Great Britain, not given separately here, shows a rapid rise in beet-sugar production—2000 tons in 1920–21; 58,000 tons in 1925–26; 321,000 tons in 1929–30.

In the British Empire excluding India the trend of production since 1920–1921 has been almost steadily upward.[4] Australia, despite its extremely high cost of production on account of the compulsory employment of white labor, shows the most rapid increase, thanks to the embargo on sugar imports that gives a monopoly of the Australian market to the home producer. The rise in production in Natal, too, where also conditions are marginal, is due to heavy protection in the domestic market. Both countries market their surplus in Great Britain, where the prefer-

[4] C. J. Robertson: Cane-Sugar Production in the British Empire, *Econ. Geogr.*, Vol. 6, 1930, pp. 135–151; *idem:* The Sugar Industry of Mauritius, *ibid.*, pp. 338–351.

ence on Empire raw sugars reduces the loss on their exports. In the British West Indies, which had already some preference in Canada, the Imperial preference has to some extent maintained and even stimulated output in recent years. In Mauritius and Fiji conditions of production are more favorable; but both areas are approaching the limits of their potential output, and production in recent years has, with the assistance of the Imperial preference, remained fairly steady.

The rapid rise of beet-sugar production in Great Britain is due entirely to the heavy subsidy on which the industry is wholly dependent, the chief limiting factor being the relatively high cost of agricultural labor. Similar considerations apply to the new industry in the Irish Free State. In Canada, too, a beet-sugar industry has grown up with various forms of government assistance.

Other Cane-Sugar-Producing Countries

Two countries that, by the lowness of their costs of production, are able, like Java, to maintain their position in the open market are Santo Domingo and Peru, and both depend largely on cheap labor. Production in Santo Domingo rose from 116 thousand tons in 1913–1914 to 366 thousand tons in 1929–1930; in Peru from 223 thousand tons in 1913–1914 to 422 thousand tons in 1929–1930.

Santo Domingo, whose production has developed rapidly in recent years, has still great potentialities and, though the expense of irrigation must be undertaken in the western districts and though hurricanes from time to time bring severe losses, has the advantage of United States capital. Peru has suitable soils skillfully cultivated under the management of the large estates that dominate the industry, although great expenditure is needed in irrigation. Production has remained at a stable level for a considerable time, for cultivation has practically reached its areal limits, the crop being confined to the lower sections of the narrow valleys and available irrigation water being fully utilized. Further intensification of methods to increase the already high yields is the only way towards expansion.

In contrast to these countries is Brazil, which was also stimulated by the high prices of the years during and immediately after the war but is now faced with the problem of disposing of a surplus produced at relatively high cost. Backward methods, labor difficulties, capital shortage, and inadequate transport facilities together militate against the sound utilization of much otherwise potentially suitable sugar-cane land. Among remaining South American countries Argentina provides an interesting comparison with Louisiana on the climatic margin of the cane-sugar zone but with an industry catering for the inland market under the protection of a high tariff. Its costs of production are possibly even higher than those of Australia.

A feature of considerable importance in the Far Eastern market has been the rapid growth of production in Formosa, owing to Japan's efforts to supply its needs, at least for home consumption, from within its own territories. The development of cane culture has been achieved by compulsion and at the same time by improvement of methods in field and factory but with heavy costs.

Beet Sugar in Europe, Including the U. S. S. R.

By far the greater part of the world's beet sugar is produced in a broad belt stretching across the great European plain from northeastern France through Belgium, the Netherlands, Germany, and Poland to the Ukraine with a very important "island" in the basins of the upper Elbe and the Morava in Czechoslovakia. This belt tends to suffer in the west from excessive moisture and in the east from frost and drought. The greatest concentration of beet culture is found where chernozems, very suitable for this crop, have developed in areas of relatively low precipitation, as in the Ukraine, parts of Saxony, in the upper Elbe basin, and in Moravia. In these areas, too, the labor supply is relatively great, whether that of peasant families or seasonal hired labor. From these relatively favored areas the sugar-beet belt has extended over the podzols and brownerths, which require much attention to render and keep them fit for the sugar beet, and to areas of rather sparser agricultural population. Spread of beet cultivation is to be ascribed in part to the important place the crop has come to hold in the agricultural rotation but largely to the high tariffs, which became a feature of the latter part of the nineteenth century, in conjunction with the cartel system and heavy direct and indirect export subsidies. By 1913–1914 Europe's production had risen to 8.3 million metric tons, and the export surplus, excluding Russia and the United Kingdom, was 2.5 million tons, equivalent to the export surplus of Cuba at the same time.

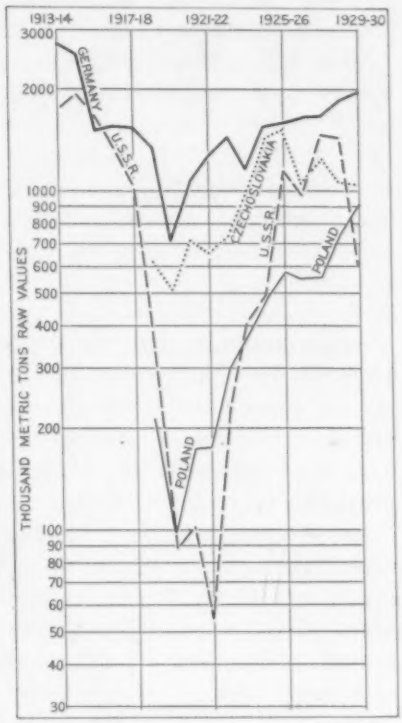


Fig. 5—Beet-sugar production in Germany, Poland, Czechoslovakia, and the U. S. S. R. According to the latest estimates of the International Institute of Agriculture the figure for Russia for 1929–30 is 834,000 metric tons.

The war caused a great decline in European production, which reached the minimum of 2.6 million tons in 1919–1920. The agrarian revolution that swept over Europe from 1917 onwards, though involving very considerable changes in ownership in the Central and Eastern European beet lands, involved only a relatively small actual transfer of land, and in every case, too, reservations were made for the special benefit of sugar-beet culture, which had in the great exporting regions been carried on chiefly by the large estates. Outside the U. S. S. R. the medium-sized and large peasant holdings in the beet lands (5 to 20 and 20 to 100 hectares respectively) have in the main strengthened their position so that sugar-beet culture has retained a relatively stable basis. In the period of low prices since 1920 the resistance of the peasant grower has proved very great, especially in the smaller holdings, where family labor and livestock production utilizing beet by-products bring about a relatively great net income per unit area. These economic factors and the determination so far shown by almost all European governments to maintain their sugar-beet area by ever higher protective tariffs in face of falling sugar prices in the world market have enabled European sugar production to recover the pre-war level and even to rise above it.

In the Soviet Union, which reached its production minimum two years after the other beet-growing countries, the factory estates have been preserved intact as *sovkhozi*, while, under the Five Year Plan, collectivization is winning back the ground that was lost to small-holding economy in the earlier years of the agrarian revolution. Mechanization is also rapidly restoring output on the rich chernozems, so that in 1930–1931 production considerably exceeded the pre-war figures.

The Future of Cane-Sugar and Beet-Sugar Production

Beet-sugar production has everywhere owed its development and, except in the Netherlands, its maintenance from 1897 to 1930, to tariffs and subsidies, which have enabled it to withstand the competition of the tropical product. There seems little doubt that, were this protection withdrawn, its production would shrink to very small dimensions and in many countries disappear. Consideration of the potentialities of cane-sugar and beet-sugar production strengthens this view. While, as the examples of Cuba and Java respectively show, unit costs of production of cane sugar can be reduced by either extensive or intensive methods suited to different sets of geographical conditions, beet sugar cannot, even with the heaviest subsidization ever practiced, be produced except by intensive methods. Acute competition of other crops for the fertile land in the temperate zones, even allowing for rotations, must also be taken into account in con-

sidering the possible extension of the beet area. A comparative study of trends in the cane-growing countries leads to the view that the future of cane-sugar production is more likely to be bound up with intensive than with extensive methods even in those countries, where, as in Cuba, extensive methods have in the past been stimulated by geographical conditions. Concentration of capital and labor and technical skill on the areas best suited to cane growing is likely, as the example of Java has demonstrated, to prove the more profitable policy. Only a very considerable rise in prices is likely to bring much fresh area under cane, the chief obstacles being difficulties of labor and transport.

The increase in the yield of sugar per unit area offers, with existing perultimate limits,[5] very much greater potentialities in the case of sugar cane than in that of sugar beet. Given these limits, the potential yield of sugar per acre from sugar cane is, according to the Mitscherlich law of growth, 18 tons, while the potential yield from sugar beet is 12 tons. Though the highest yields in the field so far recorded of sugar from sugar cane have been 88 per cent of the potential—16 tons by a company in Hawaii—and the highest for beet only 47 per cent, or 5.6 tons, the average yields of cane sugar in all countries are much further than those of beet sugar from their respective maxima, so that there is much greater leeway to be made up in the case of cane. There is also a much greater range in average yields between different regions of the cane zone than between different regions of the beet zone. In cane culture future progress is largely a matter of spreading the technique already put into practice in a small portion of the zone, whereas in beet culture progress involves a raising of a level already generally high—a much more difficult matter. For a considerable period the beet yields in the principal producing countries have shown very little increase. There are, too, great possibilities in the cane zone for the conquest of cane diseases and pests, the discovery of new varieties with higher average yields and qualities adapted to particular environments, greater possibilities, too, of improving cultivation, using fertilizers, raising the efficiency of labor, utilizing by-products, and, in some regions, improving factory practice.

The sugar beet has enormously strengthened its position in crop rotation, particularly in Europe, by the value of its by-products in the feeding of livestock. The high residual value left in the soil has had the effect, too, of spreading a considerable part of the cost of production over other crops in the rotation. Such features, in conjunction with the fact that the crop occupies the ground for a considerably less time than does the average cane crop, make the comparison of the two crops rather more difficult; but, when these are taken into

[5] For the definition of this concept see O. W. Willcox: Principles of Agrobiology, 1930; *idem:* Facts about Sugar, 23, 1928, p. 1210.

account and net costs of production are compared, there seems no doubt that the actual and prospective position of cane is very much stronger than that of beet and that the proportion of cane-sugar production is likely to show a continued upward trend. While the advantages mentioned may, with the continued assistance of tariffs and other measures of assistance, maintain the beet area, there are limits to the cost bearable by public funds and domestic consumers in the countries concerned in the attempt to neutralize geographical realities. The increase in world consumption of sugar in the future seems likely, then, to be met by the development of cane-sugar potentialities in the tropics and by increased unit yields rather than by extension of the cane area.

THE PROPOSED SECOND INTERNATIONAL POLAR YEAR, 1932–1933

J. A. Fleming
Carnegie Institution of Washington

THE importance of securing geophysical data in the polar regions has long been recognized, but rarely has it been possible to undertake scientific programs of observation simultaneously at enough high latitude stations to secure comparable data. The one notable exception is the first International Polar Year of August, 1882, to August, 1883, sponsored by the International Meteorological Organization in accordance with suggestions made in 1875 by Lieutenant Karl Weyprecht of Austria. The immeasurable enhancement in the worth of polar observations through this coöperative endeavor has been amply demonstrated by the theoretical and practical applications of some twenty volumes of data obtained during that period.

The Plan Proposed

The International Meteorological Organization held a conference at Copenhagen in September, 1929, with representatives from 34 countries present, during which there was proposed a second International Polar Year program. This proposal had its stimulus in the many new problems in the geophysical sciences that have arisen during the past fifty years. As was formally stated in the resolutions: "The Conference is of the opinion that magnetic, auroral, and meteorological observations at a network of stations in the arctic and antarctic would materially advance present knowledge and understanding of the magnetic, auroral, and meteorological phenomena not only within the polar regions but in general. The Conference is also of the opinion that this increased knowledge will be of practical application to problems connected with terrestrial magnetism, marine and aerial navigation, wireless telegraphy, and weather-forecasting."

The unanimous action taken at Copenhagen has the support of other international organizations. Thus the International Union of Geodesy and Geophysics at its Stockholm assembly during August, 1930, passed an unanimous resolution supporting the proposed program, with the statement, "Any concerted international effort for the prosecution of a simultaneous program of geophysical observations will yield data of incalculable value." This action was taken upon the recommendations of many national research councils of the various countries concerned, including particularly the National Research Council of the United States.

The following commissions of the International Meteorological Organization are also actively coöperating in the preparation of the proposed program: Exploration of the Upper Air; Terrestrial Magnetism and Atmospheric Electricity; Synoptic Weather Information; Solar Radiation; Maritime Meteorology, and Study of Clouds. The program contemplates observations also at sea and in this has the support of the Permanent Council for the Exploration of the Sea. The International Union of Scientific Radio Telegraphy has appointed a special subcommission on the advisability of making special wireless observations and at its Copenhagen meeting in May, 1931, recommended and formulated a program for scientific radio observations during the Polar Year. Many countries have designated special Polar Year committees made up of their most eminent scientists to further coöperation in the

project. Among these are Austria, Belgium, Brazil, Bulgaria, France, Germany, Great Britain, Japan, Netherlands, New Zealand, Norway, Poland, Spain, Sweden, and the Union of Socialist Soviet Republics.

Development of the Program

How carefully matters of detail for the proposed program are being developed may be seen by reference to the printed proceedings[1] of the Copenhagen conference. This volume, besides the resolutions bearing on the subject, includes various appendixes of the several commissions of the Organization summarizing the aims and objects of the magnetic, electric, auroral, and meteorological work proposed.

The development of the program has been entrusted by the International Meteorological Organization to its International Polar Year Commission for 1932–1933. Dr. D. La Cour, Director of the Danish Meteorological Institution, is the President of this Commission, which has two representatives from the United States in a total of fifteen (N. H. Heck, of the United States Coast and Geodetic Survey, and J. A. Fleming, of the Carnegie Institution of Washington). The first printed report of the Commission[2] covers the transactions of its meeting held at Leningrad in August, 1930, and includes a history of the effort and its organization, resolutions adopted for the guidance of the workers, and appendixes giving in detail reports and recommendations for observation, for equipment, and for general plans for observatories and quarters. A second meeting of the Commission was held at Innsbruck, September 25–26, 1931, at which an American representative, Professor Charles F. Brooks, was in attendance. At this meeting some fifty-seven resolutions were formulated with reference to the program (report of this meeting has not yet been published). The reports of the president and the various national committees showed that, despite the present world-wide unfavorable economic conditions, notable participation was already guaranteed. There was unanimous agreement approving the proposal that the program at Arctic stations as originally planned for the year August, 1932, to August, 1933, be adhered to, but for Antarctic stations —inaccessible in time to begin in August—for the year from January, 1933, to January, 1934.

Status of the Stations

The program proposed recommended establishing forty-three stations in the Arctic region, while in the Antarctic region—so much more difficult of access—it was proposed to establish at least five stations in addition to the permanent one operated by the Argentine government in the South Orkneys. Thus far twenty-six nations have indicated that either their governments or their national academies of sciences may participate by organizing special stations or by intensifying programs of observation at their existing stations. An important feature of the proposed program—a feature which in some senses makes the designation "Polar Year" an inadequate definition of the effort—is that the program will be carried out not only at these stations proposed but also at other existing magnetic and electric observatories (fifty-five in round numbers), as well as at a number of observatories, to be established particularly for the Polar Year, in various parts of the temperate and torrid zones. Thus the program will involve over one hundred widely-distributed stations in all parts of the world.

The Commission has asked that if possible the United States participate by occupying (1) a station in Alaska at or near Fairbanks to take the place of the

[1] See Procès-Verbaux des Séances de la Conférence Internationale des Directeurs du Comité Météorologique International et de Diverses Commissions à Copenhague, Septembre 1929. Utrecht, 1930.

[2] Premier rapport de la Commission Internationale de l'Année Polaire 1932–1933. *Secrétariat de l'Organisation Météorol. Internatl.* [*Publ.*] *No. 6*, Leiden, 1930.

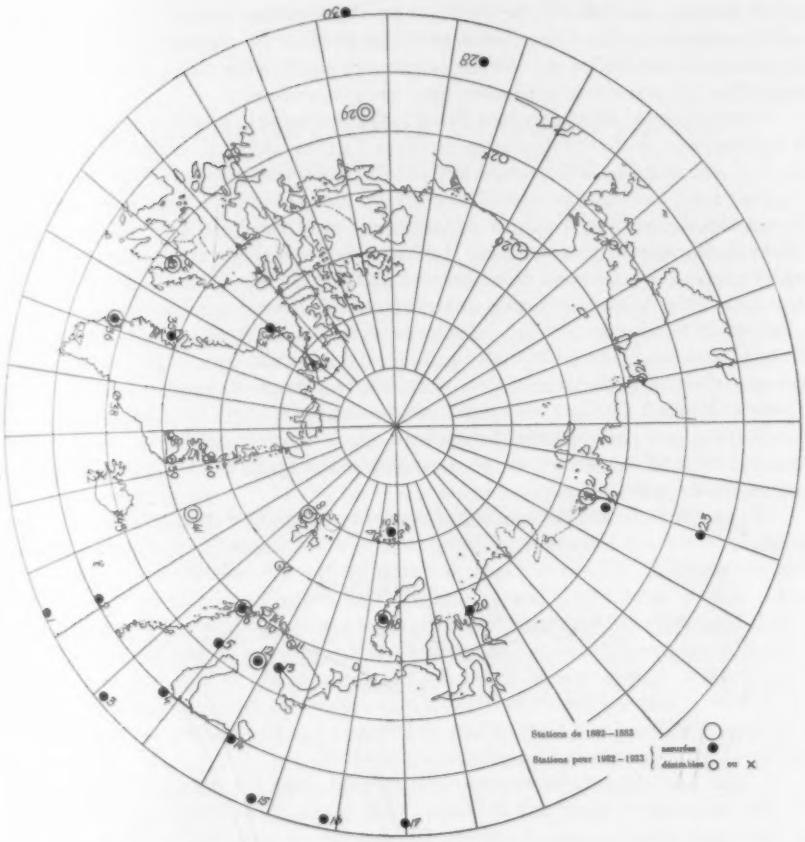


FIG. 1—Map showing proposed stations for the International Polar Year above 55° north latitude: reproduction on a reduced scale of the map accompanying "Premier rapport de la Commission Internationale de l'Année Polaire, 1932–1933," with change of the status of stations 18 and 19 to "assured." The numbers have reference: 1, Eskdalemuir; 2, Lerwick; 3, Rude Skov (Copenhagen); 4, Lovö (Stockholm); 5, Abisko; 6, Bossekop-Tromsö; 7, Bear Island; 8, Cape Thorsden; 9, Hammerfest; 10, Kautokeino; 11, Petsamo; 12, Sodankylä; 13, Kandalaksha; 14, Slutsk; 15, Kutchino; 16, Kazan; 17, Sverdlovsk; 18, Matochkin Shar; 19, Hooker Island; 20, Dickson; 21, Mouth of the Lena River; 22, Bulun; 23, Yakutsk; 24, Nijni Kolymsk; 25, Yellen (East Cape); 26, Point Barrow; 27, Fairbanks; 28, Sitka; 29, Fort Rae; 30, Meanook; 31, Chesterfield; 32, Fort Conger (Lady Franklin Bay); 33, Cape York (Thule); 34, Kingua Fiord; 35, Godhavn; 36, Godthaab; 37, Ivigtut; 38, Angmagssalik; 39, Scoresby Sound; 40, Myggbukta; 41, Jan Mayen Island; 42, Reykjavik; 43, Seydisfiord.

Point Barrow station occupied by the government in 1882–1883 and (2) the station of 1882–1883 at Fort Conger in Ellesmere Island. After scrutiny and study of the statements submitted in November, 1930, on behalf of the International Commission by Professor A. E. Kennelly and the writer, the Secretary of State has recommended an appropriation of $30,000 for an observatory and necessary instruments and for pay and transportation of personnel to establish a station at Fairbanks, Alaska. This recommendation had the favorable endorsement of President Hoover in a special message to Congress. There is already a fully equipped station for the study and measurement of auroral displays and their heights at College (three miles from Fairbanks) under the direction of the College department of physics provided for a period of five years from 1930 through the generosity of the Rockefeller Foundation. It is expected the regular meteorological observations on the Point Barrow and

other Alaskan stations will be amplified by the Weather Bureau to include special work proposed by the Commission so far as possible by current allotments. It is hoped that reoccupation of Fort Conger may be effected through a private American expedition by private subscriptions from various sources.

The American Telephone and Telegraph Company, in addition to arranging for a continuance of the earth-current work at Tucson, Ariz., in coöperation with the U. S. Coast and Geodetic Survey and the Carnegie Institution of Washington until August, 1933, has made provision to determine during the Polar Year earth potentials in the vicinity of New York, at a station in the Mississippi Valley probably near Wyanet, Ill., and at a station near Houlton, Me., as well as to continue the study of radio transmission between this continent and Europe and South America, probably also extending this investigation to include transmission from Hawaii and Japan as received in California. Other assured participants in the western hemisphere are Canada and Brazil, and Chile also has promised to take part. The Meteorological Office of Great Britain has made arrangements through a personal inspection tour of one of its staff for the reoccupation of the station at Fort Rae, in Canada.

In the eastern hemisphere the stations definitely arranged for include participation by most of the European governments not only in the Arctic and Antarctic regions but also in Africa.

Of the magnetic and meteorological stations proposed for the Arctic by the Commission sixteen are already established, fourteen are assured, six are probable, and five are possible. Of the stations proposed by the Commission for the Antarctic one is already established (South Orkneys), and one will probably be realized (New Year's Island) by the Argentine Republic; three have been assured (Kerguelen Island, Easter Island, and Tristan da Cunha) by France, Chile, and Brazil; and one (Graham Land) will probably be established by the Government of the Falkland Islands. In addition it is hoped that New Zealand may undertake the establishment of stations at Macquarie Island and Cape Adare and that one or two stations on the Antarctic continent may be occupied by private expeditions.

Of special localities in the temperate and torrid zones, France has already arranged for stations in the Ahaggar and at Dakar, while Spain will probably establish stations on the Canary Islands and Fernando Po, Belgium in the Belgian Congo, Italy in Somaliland, and Brazil at Pará. Among other special localities proposed, stations for which are being considered but are not yet definitely decided, are Cape Colony by Great Britain, a station in Asia Minor by Turkey, and stations in central China and Mongolia by China. That part of the program calling for special meteorological observations at high mountain stations in the Arctic is already assured by three established stations, ten probable stations, and four possible stations sponsored by Denmark, France, Iceland, Switzerland, Norway, Sweden, and the Union of Socialist Soviet Republics.

Upon completion of the Polar Year and publication of the resulting data by the individual governments and organizations occupying stations, it is essential that provision be made to coördinate, reduce, and compile the data under the direction of the International Polar Year Commission. After the publication of results at individual stations it is proposed to distribute the data for study and discussion to specialists who will report to the Commission, thus permitting general coördination of findings, and insuring their consideration in the broadest aspects.

It will be seen that the whole plan is an ambitious one. However, considering the advances that have been made in equipment, in technique, and along new lines of research, it is no more ambitious than the plan realized so successfully in the first International Polar Year fifty years ago.

THE INTERNATIONAL GEOGRAPHICAL CONGRESS, PARIS, 1931

FOR hospitality and effective organization the International Geographical Congress held at Paris, September 16–24, 1931, ranks among the best of the congresses of the past. More than 600 members were present out of a total Congress enrollment of 920; and, of these, 180 participated in the excursions. Forty-six countries were represented. Two hundred and eighty-seven papers were read. Thanks to the decision of the organizing committee to limit the number of topics and to make the Congress more nearly a professional undertaking, the papers were in the main on closely related themes—a reversion to the practice of the first international geographical congresses. Under six major headings, corresponding to the sections of the Congress, there were designated 35 topics among those of leading interest to geographers. While this exercised a wholesome restrictive influence, the organization of the future will no doubt provide greater flexibility in cases of exceptional importance.

The Excursions

No geographical congress of the past attained so high a level of professional excellence in the matter of excursions. Of the eight scheduled excursions, two were physiographic, three dealt with physical and human geography, and three emphasized human and economic geography.

The itineraries of the excursions took in a diversified number of natural regions in France and included Algeria. Two excursions went to the north: one to the western part of Ile de France and to Normandy under Professor A. Demangeon of the University of Paris, dealing mainly with rural life and the fishing and shipping industries (including visits to Rouen and Havre), the other to the lower Seine and Somme valleys and the coast between the mouth of the Somme and Calais to study river and shore-line physiography under Professor E. Chaput of the University of Dijon and Professor A. Briquet of the University of Strasbourg. The Jura and the French Alps were the scene of two excursions, both of which placed equal emphasis on physical and human geography. The first, under the joint leadership of Professor G. Chabot of the University of Dijon and Professor A. Cholley of the University of Paris, covered the southern part of the Jura between the Ain and the Rhone and the Pre-Alps of Savoy; the second, led by Professor J. Blache of the University of Grenoble, visited the contiguous area of the Alps of Dauphiny from the Grande Chartreuse to the basin of Queyras. Two excursions had as their objective the Massif Central, one dealing with the human and economic geography of its north-central part, the Auvergne, under the leadership of Professor P. Arbos of the University of Clermont-Ferrand, the other with the physiography of its southeastern part, including the Cévennes, under Professor H. Baulig of the University of Strasbourg. The physical and human geography of the Rhone delta region and the French Riviera were studied on an excursion conducted by Professor E. Bénévent of the University of Aix-Marseille, which included a visit to Marseilles and its port.

The excursion to Algeria, led by Professor A. Bernard of the University of Paris and Dr. M. Larnaude of the University of Algiers, was of course of special interest. From a report by Professor W. H. Hobbs, one of the nineteen participants, the following notes are taken.

Within a period of thirteen days the excursion party was taken from Paris across

the Mediterranean to Algiers and then in a specially large motor bus over mountain and desert roads a distance of 1600 miles with a pass at an elevation of over 5500 feet and a depth below sea level of some 60 feet. The outstanding success of the excursion, a model of efficient organization and execution, would hardly have been possible without the active coöperation of the French Government; for officials civil and military, proprietors of great estates, and even native chieftains vied with each other to do honor to the visitors.

The features of the excursion included studies of mountain structure in two remarkable sections across the different chains of the Atlas and of the physical processes in steppe and in true desert; the examination of Roman ruins, of life among various native tribes, the culture of the oases, and of the results of modern French colonization. Most impressive of the changes wrought since the entry of the French were: the conquest of the great marshy area south of Algiers, the Mitidja, and its transformation into a vast garden; the surprising extension of the palm groves in the oases through the artesian wells; and the great system of highways, which has opened up to regular motor travel the wide expanses of the desert. Near the gorge of the Chiffa at the entrance to the great route to Timbuctoo one can read the names of remote places with distances modestly given in some thousands of kilometers.

Four of the excursions preceded, four followed the Congress. In France they averaged six to seven days each in the field; the excursion to Algeria took thirteen days. The number of participants on each excursion was wisely limited to about thirty. Each participant was supplied with an invaluable guidebook[1] which gave both a general view of the problems of the region traversed and specific explanations of the individual features observed along the route.

The Papers Read

The papers were grouped under six sections: I, Topography and Cartography; II, Physical Geography; III, Biogeography; IV, Human Geography; V, Historical Geography; VI, Bibliography and Teaching. Six morning sessions from nine o'clock to noon on September 17–19 and 21–23 were devoted to the reading of papers, the sections meeting concurrently. Some sections required only two or three sessions to complete their programs, while Sections II and IV had to meet afternoons also. Otherwise the afternoons were left free for special events. The sessions were held in the Institut de Géographie of the University of Paris and adjoining university buildings. A booklet of 120 pages containing the abstracts of the papers was distributed at the beginning of the Congress.[2] As the Proceedings of the Congress will not be published for some time, it may be of interest to refer here to some of the major questions discussed and, without discriminating among them, to mention a few only of the many papers, in order to illustrate the range and character of the program.

In the extensive program of Section IV some of the questions under consideration were urban agglomerations, the localization of industries, and methods of representing population density. Under the first topic may be mentioned the paper by A. Zierhoffer (University of Lwów) and J. Mekarska on the recent world growth of cities (between 1875 and 1925), a subject illuminatingly discussed not long ago in these pages by Jefferson.[3] Under the third topic there were suggestive papers by Brigadier Winterbotham of the Ordnance Survey and Professor A. G. Ogilvie of Edinburgh,

[1] A complete set of eight guidebooks was given to each member on request. They vary from 25 to 60 pages in length each and are illustrated by maps, sections, diagrams, and photographs. Citation of their exact titles may be dispensed with here as the titles may be inferred and the authors identified from the reference made above to the individual excursions.

[2] Congrès International de Géographie, Paris, September, 1931: Résumés des Communications, Paris, 1931. This was later supplemented by numerous loose leaves containing abstracts received after the booklet went to press.

[3] *Geogr. Rev.*, Vol. 21, 1931, pp. 446–465.

the former presenting an experimental map showing the population density of Hampshire as derived by a new method and the latter setting forth the methods approved by the National Committee of the British Association for the Advancement of Science. But the leading activity of the section related to the rural habitat, on which under Professor Demangeon's inspiration much work had been done since the preceding congress at Cambridge three years ago.[4] The French, Belgian, and Polish schools were particularly in evidence. The abstracts of the papers read on this topic were distributed as the third report of the Commission de l'Habitat Rural.[5]

Of the topics discussed in the crowded program of Section II the determination of ancient erosion surfaces and the indicator significance of terraces were each the subject of numerous papers. Pertaining to the first topic Professor E. de Martonne spoke on the need for the precise mapping of peneplains, preferably with the use of uniform symbolism. President W. W. Atwood dealt with the correlation of ancient surfaces of erosion, and Professor H. Baulig of the University of Strasbourg presented a map in 1 : 200,000 of the Massif Central on which the reconstruction of these surfaces was attempted. On the second topic papers were read by Professor D. W. Johnson on the criteria of coastal terrace correlation and by Dr. V. Tanner of the Geological Survey of Finland on the problem of intercontinental correlation as illumined by the study of intersecting marine abrasion surfaces in Fennoscandia.

Other questions discussed in this section and papers relating to them were: the study of glacial streams and its bearing on problems of glacial erosion (L. W. Collet on the present varve sedimentation of the Rhone in Lake Geneva as a criterion for the evaluation of the amount of glacial erosion represented by ancient varves and W. H. Hobbs on the origin of loess in the glacial outwash of continental glaciers, based on studies in Greenland); the relation of karst erosion to normal erosion; and continental dunes (L. Aufrère, classification according to the forms created by the wind and according to stage of development). Climate was represented by discussions of the definition and study of local climates (Charles F. Brooks) and climatic variations and their historical significance (Arctowski).

In Section III papers by A. Chevalier, director of the Institute of Colonial Agronomy at the Natural History Museum of Paris (on the origin of plants common to Africa and South America) and by A. J. de Sampaio, chief of the botanical section of the National Museum of Rio de Janeiro (on the value of phytogeography and plant ecology to taxonomic botany, especially in Brazil) may be mentioned. In this section was also presented the work of the commissions on the study of plant and animal associations in high mountains and on paleogeographic (Pliocene and Pleistocene) maps of the habitat of primitive man, the triennial report on the latter being presented by Count Costantini, chairman of the commission.

Topography and cartography were dealt with both in Section I and Section V. In the former some of the topics under discussion were aerial phototopography, surveying in high mountains, and the representation of relief on maps. Under the last heading mention should be made of a paper by Professor B. Zaborski of the University of Cracow that discussed a new method, based on form, size, slope, and density of occurrence, of representing the relief features of plains—elements that the usual contour or other relief map does not treat adequately. The paper was illustrated by an excellent map of the surface form types of the North European Plain in Poland, East Prussia, and Lithuania in 1:1,250,000. Professor Eugene Romer of the University of Lwów presented a new method of establishing the hypsographic curve, or curve representing the volume of land or water at given elevations above or below sea level, which took better account of the three-dimensional aspect of the problem.

[4] *Geogr. Rev.*, Vol. 18, 1928, pp. 661–667; reference on p. 665.

[5] Union Géographique Internationale: Troisième Rapport de la Commission de l'Habitat Rural preparé pour le Congrès International de Géographie, Paris, 1931, par A. Demangeon, 48 pp., Paris, 1931.

Important new atlases were announced to the Congress, two modern and two historical. The French National Committee of the International Geographical Union presented three sheets of a new atlas of France[6] (hypsometry and population density of southwestern France, 1 : 1,250,000, mineral resources of France, 1:2,500,000). Professor V. Švambera of the University of Prague announced the forthcoming publication, under the auspices of the Czech Academy of Sciences, of an Atlas of Czechoslovakia in 54 sheets on the scales of 1:1,250,000 and 1:5,000,000, being engraved by the Military Topographical Survey and to be completed within a year. Professor Švambera also announced the beginning of publication by the Institute of Geography of the University of Prague of a facsimile series of historical maps of Czechoslovakia. Professor L. C. Karpinski of the University of Michigan presented an Historical Atlas of the Great Lakes and Michigan to illustrate the cartographic evolution of the Great Lakes and to accompany a Bibliography of the Printed Maps of Michigan (to 1880) published by the Michigan Historical Commission.

The Commission on the Map of the Roman Empire in 1 : 1,000,000 also reported to Section V, Brigadier Winterbotham submitting two completed sheets. Professor J. Tourneur-Aumont contributed an interesting corollary paper as to what constituted the boundary of the Roman Empire, demonstrating from classical sources that in the minds of the Romans themselves this was a shifting zone of balancing forces, between themselves and the barbarians, and not a definite line.

Resolutions

The continuity of the congresses is in part maintained by the work of the permanent commissions; the work of each congress is crystallized, as it were, in the resolutions passed by the various sections. Those that receive the approval of the Executive Committee of the Congress are then referred to the International Geographical Union for action. Nine resolutions were referred to the Union. They recommend that: (1) a commission on aerial photographic surveying be appointed; (2) the official topographical surveys be invited to present to each International Geographical Congress a report on the topographical and cartographical work executed in the three years preceding the congress at which the report is made;[7] (3) the accurate mapping of old erosion surfaces be undertaken; (4) the work of the Commission on Plant and Animal Associations in High Mountains be continued and extended; (5) the Commission on the Rural Habitat be continued, that subcommissions be created in those countries that have organized research in this field, and that periodical meetings of the Commission be held between congresses; (6) the International Geographical Union extend its patronage to a publication to be entitled "Monumenta Europae Cartographica," which would comprise source maps of primary importance in the development of the cartography of Europe, and likewise to the various facsimile series of old maps of historical and regional interest that are now appearing in different countries; (7) the Bibliographie Géographique Annuelle, now in its fortieth year, which has for about ten years ceased to be exclusively French, thanks to the spontaneous coöperation of institutions and individuals in different countries, be made still further international by extending the range of this collaboration and that an advisory committee be formed to promote such general coöperation; (8) in secondary and primary education in geography laboratory work be assigned a definite place in the curriculum; (9) a commission be appointed to study the problem of overpopulation in relation to regional and geographical conditions.

[6] Atlas de France, Livraison spéciale offerte aux membres du Congrès International de Géographie de Paris, 1931.

[7] For France this wish was anticipated by the Service Géographique de l'Armée, which published an excellent brief survey of its work, with index maps (Service Géographique de l'Armée: Travaux Topographiques et Cartographiques, Situation en 1931: Rapport présenté à l'occasion du Congrès International de Géographie, Paris, septembre, 1931, 16 pp., 8 plates, Paris, 1931).

Special Events

In addition to the regular program there were special events, both professional and social.

Of particular interest were the two exhibits of old maps especially prepared for the Congress, one at the Bibliothèque Nationale, the other at the Service Hydrographique de la Marine. At the former the curator, Monsieur de La Roncière, made an address describing some of the maps of the collection. At the Service Hydrographique the members found spread out before them, not facsimiles, but the originals themselves of such priceless treasures as the world map of Canerio, 1502, and a portolan of Vesconto de Maiollo, 1537. A visit was also made under special guidance to the collection of relief models of the Service Géographique de l'Armée in the Hôtel des Invalides. These large-scale models, many of them in 1:600, are realistic reproductions in miniature of towns and other strategic places that have played a rôle in the military history of France from the time of Louis XIV to the Franco-Prussian War, including many bearing on the Napoleonic Wars.[8] The tools of modern geography were represented by an extensive exhibit in the headquarters building of the Congress of official French maps, topographic sheets, wall maps, regional geographies, etc. This exhibit included a valuable display of maps, photographs, and diagrams relating to the rural and urban geography of Japan, partly supplied by Professor T. Odauti of the Japanese Ministry of Education.

The outstanding special feature was the Exposition Coloniale. At this exposition, to which each member received a ticket entitling him to free admission during the Congress, the geographer was able to gain a systematic and impressive survey of the French colonial empire,[9] of all the greater interest because that empire embraces territories and civilizations of such diverse nature.

The Congress was opened at a formal session in the amphitheater of the Sorbonne on the afternoon of September 16 under the chairmanship of General Bourgeois, President of the International Geographical Union, who made the address of welcome. Brief responses were made by representatives from Italy, Poland, the United States, and Egypt. Professor de Martonne, Secretary-General of the Congress, gave an outline of the various arrangements relating to the procedure of the Congress. The Minister of Public Instruction spoke on behalf of the French Government. On the afternoon of September 17 there was a reception at the Hôtel de Ville by the Municipal Council of Paris. The next afternoon the members were guests of the Institut de France at the splendid Chateau of Chantilly, 25 miles north of Paris, bequeathed to it by the last of the Condés. The Geographical Society of Paris entertained the members in the evening of September 21. A specially pleasant occasion for the dozen or so members concerned was a luncheon reunion of participants in the American Geographical Society's Transcontinental Excursion of 1912, from which cordial greetings were sent to Professor W. M. Davis. The closing session of the Congress took place on the afternoon of September 24 in the Institute of Oceanography founded by the Prince of Monaco, and on that evening the Congress formally ended with a dinner tendered by General and Madame Bourgeois to the official delegates and a reception to the members.

---

[8] These three exhibits are briefly described (pp. 3–17, 17–18, and 18–21) in the Livret-Guide du Congressiste that each member received. This 44-page booklet also contained information as to location of meetings, the regulations of the Congress, and the list of members to September 1 (a lithographed "Liste Definitive" was distributed later).

The collection of relief models is described in greater detail, with historical notes and photographs, in Catalogue-Guide du Musée des Plans-Reliefs (Hôtel National des Invalides), xxvii and 127 pp., Service Géogr. de l'Armée, Paris, 1928.

[9] A survey of the cartography of the French colonies is provided in Édouard de Martonne: La cartographie à l'Exposition coloniale de Vincennes, *Ann. de Géogr.*, Vol. 40, 1931, pp. 449–478 (preprint distributed to members as a Congress publication).

Organization for the Next Congress

The great success of the International Geographical Congress of Paris, 1931, and its high scientific character are mainly due to the indefatigable efforts of the Secretary-General, Professor de Martonne, ably seconded by his colleagues and an alert and intelligent corps of students. At the general assembly of the International Geographical Union it was voted to hold the Congress of 1934 in Warsaw. The following officers were elected for the term 1931–1934: President, Isaiah Bowman; Secretary-General, Emmanuel de Martonne; First Vice-President, General Bourgeois; Vice-Presidents, General Vacchelli, General Gómez Núñez, Brigadier Winterbotham, and Professor Romer.

To the great regret of all members of the Congress the German delegation was unable to attend because of the extreme financial difficulties that confronted the government during the summer months. It will be remembered that the statutes of the International Research Council were changed and that international body was itself designated the International Council of Scientific Unions. In conformity with that change the statutes of the International Geographical Union were also modified, thus permitting German geographers to associate on acceptable official terms with their colleagues in other countries. It is a satisfaction to record that the last difficulty is now happily removed and that international geographical congresses of the future may expect to have the fullest representation.

AMERICAN GEOGRAPHICAL SOCIETY

The November Meeting. The first regular meeting of the American Geographical Society for the season 1931–1932 was held on November 24, 1931, at the Engineering Societies' Building, 29 West 39th Street, President John H. Finley in the chair. The address was delivered by Dr. Gunnar Horn on "The Last Camp of the Andrée Balloon Expedition." Dr. Horn was scientific leader of the Norwegian expedition to Franz Josef Land, 1930, that stopping en route at White Island discovered the camp of Andrée's ill-fated expedition of 1897. Dr. Horn told the story of the expedition as revealed by the diaries and relics that were found, illustrating it with photographs taken by himself and by photographs developed from negatives found in the Andrée camp and exposed over thirty years ago.

At the meeting there were presented with the approval of the Council the names of 383 candidates who were duly elected as Fellows of the Society.

Presentation of the Charles P. Daly Medal for 1930 to Lauge Koch. The Charles P. Daly Medal for 1930 was presented to Dr. Lauge Koch at Copenhagen on September 18, 1931 (compare *Geogr. Rev.*, Vol. 20, 1930, p. 504). An announcement of the award had previously been made at a dinner tendered Dr. Koch by Mr. North Winship, American Chargé d'Affaires. The presentation ceremony took place at the Legation in the presence of a selected and representative group comprising the Prime Minister, Mr. T. Stauning, Danish officials, explorers, scientists, officials of the Legation and Consulate General, and leading American residents in Copenhagen.

In presenting the medal Mr. Winship said:

"We are gathered here today to do honor to a renowned son of Denmark, a young man esteemed at home and abroad for courage and directness of purpose in his explorations which have brought him world fame and recognition.

"Dr. Lauge Koch, an outstanding member of the Greenland Geological Survey—explorer, topographer, geologist, author, lecturer, recipient of numerous and important decorations, medals, and distinctions—has, as we are all gratified to know, been awarded the Charles P. Daly Medal for 1930 by the American Geographical Society. . . .

"Dr. Koch was at that time invited to visit the United States and to deliver a series of lectures, after which the medal was to have been presented with due ceremony at the spacious home of the American Geographical Society in New York. . . .

"When Dr. Koch was unable to accept this flattering invitation, the place for the presentation was transferred to the American Legation in Copenhagen.

"And now, Sir, by direction of my Government and on behalf of the American Geographical Society, I have the signal privilege and honor to present to you this coveted token of recognition for your explorations in Greenland and your interpretations of the physical geography of that country—and may I at the same time extend my felicitations for this new honor which you so highly deserve."

In accepting the medal Dr. Koch said:

"It was no easy matter for me about a year ago to write to my friend Dr. Bowman, the Director of the American Geographical Society, to inform him that it was impossible for me to go to New York to receive the medal. . . .

"I am, however, very glad to receive today the medal from your hands, Mr. Winship. . . . You stand today as the official representative of the American nation and it is a special pleasure to me to have you present it to me. . . .

"Standing with this medal in my hands I think of a number of American ex-

plorers who have worked in Greenland, more especially in the regions of Greenland with which I am familiar. I may mention Kane, Hayes, Hall, Greely, Lockwood, Brainard, and Peary. You called me a young man. I am, however, old enough to know personally Greely and Brainard, as also Robert Peary, certainly the greatest of them all, one of the greatest explorers of his time and no doubt the greatest commander of men the Arctic has ever seen. Many times during my journeys when things proved difficult, the thought of Peary has given me new strength.

"In conclusion I wish to repeat my thanks to you, Mr. Winship, for presenting me the medal, asking you to convey my thanks to the American Geographical Society for the great honor it has bestowed on me and at the same time on Danish exploration and science in Greenland."

Presentation of the Charles P. Daly Medal for 1931 to Major Gunnar Isachsen and of the David Livingstone Centenary Medal for 1931 to Captain Hjalmar Riiser-Larsen. Presentation of the Charles P. Daly Medal for 1931 to Major Gunnar Isachsen and of the David Livingstone Centenary Medal for 1931 to Captain Hjalmar Riiser-Larsen took place at the American Legation, Oslo, on September 30, 1931. The presentation was made by His Excellency the American Minister, the Honorable Hoffman Philip, in the presence of a distinguished gathering of representatives of governmental, diplomatic, and scientific circles.

In presenting the medals Minister Philip said:

"I have taken the liberty of inviting you to meet here this morning to assist in offering to two distinguished Norwegians a testimonial of the high regard and admiration in which they are held in my country. I am sure that you will all share with me the great pleasure it gives me to do this.

"I have had the honor to be requested by the Council of the American Geographical Society, with the approbation of the Department of State, to act on its behalf in presenting to Major Gunnar Isachsen the Charles P. Daly Medal for 1931, and to Captain Hjalmar Riiser-Larsen the David Livingstone Centenary Medal for the same year.

"It is a relief at this moment of stress and uncertainty in the affairs of the world to switch our thoughts from the unsatisfactory political and economic conditions with which the peoples of all countries are faced and to contemplate the achievements of men who are striving, frequently in circumstances of greatest personal hazard and sacrifice, to contribute to the knowledge and the welfare of mankind.

"Such work as this is carried out in the non-partisan realm of science, and the ambition which inspires it is the unselfish desire to contribute to the welfare of all nations. To succeed in such endeavor a man must have not only intelligence of a high order but the stern qualities of physical endurance and unlimited patience combined with great energy.

"It is fitting, therefore, that we who benefit by the results of their labors should endeavor to express to these men our gratitude. . . .

"The American Geographical Society of New York has awarded its well known Charles P. Daly Medal for 1931 to Major Gunnar Isachsen for his distinguished contributions to our knowledge of the Arctic and especially for the surveying and mapping of northwestern Spitsbergen and the surrounding waters and for his studies of the whaling industry in the course of exploration in the Antarctic.

"Major Gunnar Isachsen, I have the honor and the very great pleasure on behalf of the American Geographical Society of New York to present to you the Charles P. Daly Medal for 1931, which is offered as a testimonial of the appreciation which is felt in the United States for your fine contributions to science.

"The David Livingstone Centenary Medal which has been awarded to Captain Hjalmar Riiser-Larsen was founded by the Hispanic Society of America in 1913 and is awarded for scientific achievements and exploration in the southern hemisphere.

I think I am correct in stating that Captain Riiser-Larsen is the first Norwegian to have won this award. Among other recipients of the honor is Señor Don José M. Sobral, Argentine Consul-General at Oslo, whom I have the pleasure of seeing with us this morning.

"Captain Hjalmar Riiser-Larsen joined the Royal Norwegian Navy in 1912. He participated in two notable expeditions: first, the Amundsen-Ellsworth Polar Flight in 1925, and subsequently the flight of the *Norge* across the Polar Sea in 1926. In these expeditions he proved himself a most skillful navigator of both airplanes and airships. In 1929–1930 Captain Riiser-Larsen was commander of the *Norvegia* on the expedition which carried out explorations in the sector between Enderby Land and the Weddell Sea. . . .

"Captain Riiser-Larsen, it is with very great pleasure that I act on behalf of the American Geographical Society of New York in begging you to accept this medal as a recognition of the fine work you have accomplished."

In replying Major Gunnar Isachsen said:

"On behalf of Captain Riiser-Larsen and myself I will say that we are very glad to receive these medals from the hands of His Excellency the Minister of the United States of America for Norway. The relations between America and Norway began, we may say, a thousand years ago, with our Leif Ericsson's discovery of America. Since then we have had relations of many kinds. And now we meet in common interest in modern exploration. We beg Your Excellency to convey our thanks to the American Geographical Society for the honor it has done us in placing us among the distinguished recipients of these medals and accept, Sir, the expressions of sincere and hearty gratitude."

Professor Johan Hjort of the University of Oslo also made a short address in which he emphasized the strong bonds of interest and affection which exist between the scientific workers in Norway and those of the United States.

After the presentation ceremony the gathering was entertained at luncheon.

Presentation of the Cullum Geographical Medal for 1929 to Jules Schokalsky. The Cullum Geographical Medal for 1929 having been awarded to Professor Jules Schokalsky of Leningrad (see *Geogr. Rev.*, Vol. 20, 1930, p. 313), a suitable occasion was awaited for its presentation. Professor Schokalsky attended the International Geographical Congress at Paris in September, 1931, as an official delegate of the Soviet government; and at a luncheon on September 22, at which the French members of the American Geographical Society's Transcontinental Excursion of 1912 were hosts, occasion was taken to make the presentation. The medal bears the inscription

JULES DE SCHOKALSKY
FOR ORIGINAL CONTRIBUTIONS
TO THE PHYSICAL GEOGRAPHY
OF THE
RUSSIAN DOMAIN
AND ITS BORDERING SEAS
1929

In accepting it Professor Schokalsky spoke feelingly of his pleasure in greeting old friends under such happy circumstances and of the encouragement he received from the Society's recognition of his hydrologic and oceanographic work.

Award of the Cullum Geographical Medal for 1931 to Mark Jefferson. The Cullum Geographical Medal, one of the gold medals of the Society, has been awarded to Professor Mark Jefferson of the Michigan State Normal College. The presentation

will be made at the twenty-eighth annual meeting of the Association of American Geographers held at Ypsilanti, Mich.

Readers of the *Geographical Review* will not need to be informed of the conspicuously original quality of Professor Jefferson's work, many of his papers having been published by the Society. Among these are "Looking Back at Malthus" (April, 1925), "Actual Temperatures of South America" (July, 1926), "The Geographic Distribution of Inventiveness" (October, 1929), "Distribution of the World's City Folks" (July, 1931). In addition, the Society published Professor Jefferson's monographic study entitled "Peopling the Argentine Pampa," which has been widely read and has had a deep influence not only in American geography but also among Argentine leaders. This book and his "Modern Colonization in Chile," as well as "The Rainfall of Chile" and a number of shorter papers were the result of an expedition which Professor Jefferson led in 1918 to the ABC countries and which was made with the support and under the auspices of the Society.

Recent Publications

Studies in Pioneering. There has just been published by the Society a study of modern settlement entitled "The Pioneer Fringe" by Isaiah Bowman. It is introductory to a second volume now in press entitled "Pioneer Settlement," written by thirty authors with first-hand knowledge of the frontier areas with which they deal. "The Pioneer Fringe" contains an announcement entitled "The Plan" which shows the setting of these two volumes and other studies under way to the general plan of research supported by the Social Science Research Council, the National Research Council, and the American Geographical Society.

The "Pioneer Fringe" is divided into two parts: The Generalities, consisting of seven chapters which summarize the ideas that have inspired the study, and Regional Examples consisting of seven chapters on the leading pioneer areas or "belts" of the world. There are 350 pages, which include 175 photographs and 75 maps and sketches. The book was chosen by the Scientific Book Club for its December distribution.

The Grand Coulee. One of the great and also one of the most puzzling physical features of the United States is the theme of a book by J Harlen Bretz. It has just been published by the Society as Special Publication No. 15. The feature is marked by a dry canyon and a waterfall five times as high as Niagara and seven times as wide located in central Washington; and the theory is set forth that they are the product of a vast flood due to the sudden bursting of an ice dam in glacial times. There are reproduced 37 photographs, most of them aerial views and many of them accompanied by interpretative diagrams; and eight stereoscopic views are provided which enable the reader to look into canyon and falls as if he stood on the brink. A map in color, text maps, diagrams, and block diagrams enable the reader to gain a clear view of the relations involved. There are 100 pages of text and illustrations. The Society's Transcontinental Excursion of 1912 visited Grand Coulee in 1912, and the International Geological Excursion of 1933 will also study it.

Distribution of Title Page, Contents, and Index of Volume 21 of the Geographical Review. The title page, table of contents, and index for Volume 21 of the *Geographical Review* (1931), which is issued separately, is ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

GEOGRAPHICAL RECORD

NORTH AMERICA

The Great Plains. Behind the glamour and romance of the Great Plains, developed and fostered by the Wild West show, by the cowboy film, and by the flood of western magazines and novels, is a story of economic and cultural development and conflict not understood or appreciated even by scholars in the region. Three recent studies, "The Great Plains" by Walter Prescott Webb (Ginn and Co., Boston, 1931), "The Range Cattle Industry" by Edward Everett Dale (University of Oklahoma Press, Norman, 1930), and "The Day of the Cattleman" by Ernest Staples Osgood (University of Minnesota Press, Minneapolis, 1929), should go a long way toward placing the Great Plains region and the range cattle industry in their proper places in the study of the economic life of the United States.

Professor Webb has shown that the Great Plains, lacking any semblance of a native civilization which Spain could "conquer, convert, exploit, and incorporate" as she did in Mexico, stood out as an insurmountable barrier to Spanish expansion even though the Spanish explorers were not intimidated by the arid climate. When the American pioneer emerged from the eastern forest and woodland into the prairies and plains, the lack of water and wood and the fact that the Great Plains were occupied by the most ferocious of horse riding Indians, made the region even more formidable to them than it had been to the Spanish.

"New inventions and discoveries had to be made before the pioneer farmer could go into the Great Plains and establish himself. . . . In time the Industrial Revolution was to develop agencies that enabled him to go forward and solve the problems of water and fence and extensive agriculture which hitherto had been insoluble. While these inventions and adaptations were being worked out, improved, and perfected, the agricultural frontier stood at ease, or, more aptly, stamped about in uneasiness along the borders of the Plains country. In the interval of awaiting the Industrial Revolution there arose in the Plains country the cattle kingdom.

"The cattle kingdom was a world within itself, with a culture all its own, which, though of brief duration, was complete and self-satisfying. The cattle kingdom worked out its own means and methods of utilization; it formulated its own law, called the code of the West, and did it largely upon extra-legal grounds. The existence of the cattle kingdom for a generation is the best single bit of evidence that here in the West were the basis and the promise of a new civilization unlike anything previously known to the Anglo-European-American experience. . . . Since the destruction of the Plains Indians and the buffalo civilization, the cattle kingdom is the most logical thing that has happened in the Great Plains, where, in spite of science and invention, the spirit of the Great American Desert still is manifest."

Professor Webb explains how the various difficulties in the way of agricultural settlement of the Plains region were gradually and partially overcome. The problem of transportation was solved by railroads, that of fencing by the invention of barbed wire, the problem of water by the introduction of windmills, and that of the actual farming operations by new farm machinery and by a new form of agriculture.

The process of railroad construction changed completely when the Great Plains were encountered from the east. In the East railroads followed settlement and were supported by the areas into which they went. In the Great Plains "the roads ran far ahead of population and had to subsist for a long time on government aid or outside capital."

The problem of fencing proved to be one of profound importance and engrossing interest. In 1871 the cost of fences in the United States was computed to be $1,747,549,931, with a total annual expense of $200,000,000. "This exhibit makes the cost of fences nearly equal to the total amount of the national debt on which interest is paid, and about the same as the estimated value of all the farm animals in the United States." In the Great Plains the rail fence of the East was clearly out of the question, as were stone and stump fences. Board fences were tremendously expensive and "comparatively worthless in resisting the assaults of stock." Hedge fences were tried, but they too were costly and undependable and were slow to develop. Barbed wire solved the problem. The invention "revolutionized land values and opened up to the homesteaders the fertile prairie plains, now the most valuable agricultural land in the United States."

"The scarcity of moisture . . . is the crux of the whole problem of conquering the Great Plains." "Dry farming, which is the science of farming where rainfall is deficient, brings forth crops with a minimum of rainfall. Windmills and artesian wells make small areas—areas infinitely small—yield in abundance. Yet, by and large, so far as successful agriculture is concerned, all these agencies put together provide comparatively but a drop of water in an empty bucket. . . . In the Great Plains there is a little water, which is very profitable to the first few; but there is not enough to go round, not enough for the multitude, and as yet science has not been able to perform the miracle that was performed with the loaves and fishes. Nor does science promise to do so." "The windmill mitigated the thirst of the Great Plains but did not assuage it. The search for water had to go on."

In Professor Dale's "The Range Cattle Industry" the historical and economic factors which occasioned the rise and later decline of the industry are evaluated in a thoroughly satisfactory manner. Dr. Dale points out that the economic stimulus which brought about the first cattle drives was the great price differential at the close of the Civil War, between the eastern states, both north and south, where the herds of livestock had been practically annihilated, and Texas, where cattle had increased greatly in numbers on the open range; three-year-old steers were quoted at $86.00 in Massachusetts, $40.19 in Illinois, $46.32 in Nebraska, and only $9.46 in Texas.

This is the story of an unusual epic in land settlement where two streams of contrasting cultures came into economic and ultimately into mortal conflict. The movement of the eastern farmers into the prairies and the Great Plains is not entirely unfamiliar, but the northward thrust of the Texas cattlemen into the same area is not generally appreciated. The spectacular opening of the Oklahoma country to the farmer merely hastened the natural process of displacing the cattlemen from the grasslands, until in recent years the range cattle industry has been forced into areas unsuited for agriculture where cattle are kept only to the age when they are ready for feeding on the farm.

Whereas Dr. Dale deals primarily with the southern Great Plains area, Osgood in "The Day of the Cattleman" is particularly concerned with the northern Great Plains. In part, both men tell the same story, but the individual problems of the ranges prove to be different. Texas fever was dreadfully significant to the southern ranchers, and winter blizzards to those of the north.

Various aspects of the problems concerning the disposal of the public domain and the development of new laws for land and water are presented by Webb and Osgood. The projection of the land policy evolved for the old Northwest Territory into the Great Plains region was shown to have been little short of idiotic. Webb says, "Had the land system of the Great Plains been made *ab initio*, or had it been made by people with a desert or semiarid background, such as the Spaniards had, it would have borne little resemblance to the general land system of the United States. The Spaniards . . . had an excellent understanding of the problem before them in

northern Mexico, and established a system which theoretically was well adapted to the Great Plains and the intermountain region." The homestead act "gave a great impetus to the advancing frontier while it remained in the fertile prairie region," but how was a home to be made on 160 acres of arid or semiarid land? "It required more than twenty years of experimentation to show that in terms of utilization 160 acres of land in the humid region was equivalent in productiveness to 2560 acres in the arid region, but that knowledge and conviction were limited to a few and have probably not yet become general."

It is remarkable that three men all possessing a first-hand acquaintance with the Great Plains should have worked, each in ignorance of the others, and produced at about the same time three volumes on the same theme, without the misfortune of any appreciable overlapping of effort. All three works articulate as well as though they had been written under editorial supervision. It is certain that anyone who wishes to understand either the history or the present problems and state of mind of the Great Plains region or who is interested more generally in the processes of settlement of land on the agricultural frontier will find these three books indispensable.

C. W. THORNTHWAITE

SOUTH AMERICA

Rio de Janeiro. Rio de Janeiro is one of the world's "great cities" and one of the few cities of more than a million inhabitants that have grown up in the lower latitudes. Not only is this city unique as regards its site but also as regards the tempo of its growth and the changes in the racial composition of its population. A summary of these peculiarities is set forth by Otto Quelle in a study based largely on census material and maps available in Germany (Rio de Janeiro: Beitrag zur Geographie einer tropischen Grosstadt, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1931, pp. 241–257).

Rio de Janeiro has not exhibited during the last century the enormously rapid growth characteristic of most of the world's great cities. Only during the last decade has it shown any of the remarkable vitality characteristic of western great cities. The first important period of growth began with the arrival of the Portuguese court in 1808. During the early nineteenth century the increase of population was about in proportion to the increase in the country as a whole. However, after 1888, when the slaves were given their freedom, a rush of negroes to the cities and especially to the coastal cities took place, much as in our own southern states after the Civil War. Even so, the increase of population during the century has not been as great as in other cities of similar size. For example, from 1869 to 1920 Buenos Aires increased its population nine times, while from 1872 to 1920 Rio de Janeiro increased only five times. The immigrants to Argentina remained in Buenos Aires: but those who entered Brazil did not remain in Rio de Janeiro but went inland, chiefly to the coffee lands.

The racial make-up of the population has gone through a rather spectacular transformation during the history of the city. The earliest data are for 1585, at which time out of 3850 people, 78 per cent, or roughly 3000, were listed as "indios civilisados." Rio at that time was essentially an Indian town. Negroes began prominently to figure in the population after 1609. In 1821 practically half the population was pure negro; and between 1820 and 1829 more than 250,000 negro slaves were brought to the Rio market. The latest data available on racial composition were for 1890, when only 12 per cent were listed as pure negro and 21 per cent as mulatto. Too much trust, however, should not be placed on such figures, as they come from a country where racial distinctions are not easily or naturally maintained.

The economic structure of Rio de Janeiro has also undergone a considerable trans-

formation. The colonial city was a purely agricultural center. Sugar plantations were set out even within the bounds of the present urban area: in fact the persistence of certain high class residential districts dates from the sixteenth century, when the wealthy proprietors of sugar estates established their *fazendas* in these places. The sugar "centrals" were the first industries of the growing town. The function of Rio as a shipping and commercial center grew with the settlement of its immediate hinterland, especially of the coffee lands of the Parahyba Valley. However, real industrial development has come only quite recently. Of the present industries in the city only 9 per cent had their origin before 1889, and only 41 per cent between 1889 and 1914. Half of the industries in operation in 1920 were established during the war period from 1915 to 1919, when imports of manufactured articles were curtailed. The 1920 census shows that 32 per cent of the population was engaged in industry, 18 per cent in commerce, 14 per cent in household service, and 9 per cent in transportation.

As a focus of shipments, Rio has played various rôles in the course of its history. Before the development of railroads the swampy land to the north and the mountains to the west served effectively to isolate the city from its hinterland. The sugar, coffee, hides, cotton, and tobacco produced in São Paulo and southern Minas Geraes were brought by muleback to the little port of Estrella on the shores of Guanabara Bay and from there carried in small boats to Rio. Even the first railroad in 1854 ran from Mauá, on the northern side of the bay, inland for 14½ kilometers to the foot of the mountains below Petropolis. However, with the extension of the railroad lines, which began to reach out radially from the shores of the bay, a connection was made across the swamps to the city. But, Rio de Janeiro has never been as important to Brazil as Buenos Aires has been to Argentina, since a number of other ports have competed with it for commercial prestige. With the shift of the coffee zone farther westward into the state of São Paulo, most of the coffee exports now find their way out through Santos; and in 1928 Santos was only a little behind Rio in its imports.

PRESTON E. JAMES

The Humboldt and Niño Currents. Striking climatic contrasts along contiguous tropical seaboards and economically serious vagaries of oceanographic and meteorological conditions have combined to turn recent scientific attention toward the Humboldt Current. Geographic literature bearing on the subject has been fairly voluminous since 1925, the year of the latest "abnormal" phenomena. Professor Gerhard Schott has now interpreted by the dynamic method a wealth of disjointed observation, including important but hitherto fallow data recorded during the famed season of 1891 (Der Peru-Strom und seine nördlichen Nachbargebiete in normaler und anormaler Ausbildung, *Annal. der Hydrogr. und Marit. Meteorol.*, Vol. 59, 1931, pp. 161–169; 200–213; 240–253; also Der Peru- oder Humboldtstrom, *Forschungen und Fortschritte*, Vol. 7, 1931, pp. 373–374).

The cool coastal current takes its origin not from latitudes bordering the Antarctic but in the west wind zone, from where it passes into the sphere of the trade wind. The current is of relatively high salinity and is most strongly marked during the southern-hemisphere winter. The isotherms of surface water are usually parallel with the coast line, but occasionally they lie east-west because of upwelling from cool substrata. Sharp bends in the continental outline, as at Arica, enhance and complicate these effects so that the northerly coastal waters are frequently of lower temperatures than those to southward.

The upwelling phenomena responsible for such anomalies begin a little north of Coquimbo and are active as far as Paita. Increasing breadth of the coastal shelf especially favors upwelling, which sufficiently explains the fact of cooler water in the tropical sector. The temperature correlations amend the views of Murphy, whose data led him to infer strong upwelling along the steepest submarine slopes

(The Oceanography of the Peruvian Littoral . . . , *Geogr. Rev.*, Vol. 13, 1923, pp. 64–85). His other conclusions are all supported by Professor Schott.

Coastwise observations made during the months of September and November show that to southward of Paita lower surface temperatures are accompanied by lowered salinity. North of Paita, in the equatorial section of the coastal Pacific, the reverse is true. Because of this Schott is entirely in accord with Sverdrup's recent findings that upwelling in the Humboldt Current is practically limited to the upper 200–300 meters.

The area covered by the studies is roughly from latitude 30° S. to 10° N. and from the coast to longitude 100° W., 500 sea miles west of the Galápagos. The oceanic zones, in a broad sense, are those of the Humboldt Current, the equatorial countercurrent, and the north equatorial current.

Throughout the whole area under consideration, the oceanic régime is least stable and most complex during the winter months of the northern hemisphere. Thus the equatorial countercurrent reaches latitudes south of the equator during February-March but never during August-September. Data from as far as 600 sea miles west of the continental coast demonstrate that the Niño disturbances of 1891 and 1925 were caused by widespread movement of the tropical ocean surface into southern latitudes, which resulted in the forcing of warm and less saline waters against the coast to eastward and southward, displacing or overflowing the cooler, saltier waters. The opinion that any part of this vast mass of warm water issued from the Gulfs of Guayaquil or Panama is untenable. During the very period of the Niño effect the embayed waters just referred to show a temperature decrease of from 4° to 8° C., with an increase in salinity. Indeed, during both 1891 and 1925 a cold current is recorded as flowing from the Gulf of Panama at the peak of the Niño disturbance farther southward. It is clear that in the seasons of its notable outbreaks the Niño movement draws water from the open Pacific—that it amounts to an invasion into the southern hemisphere of the equatorial countercurrent.

The distribution of salinity in the eastern tropical area of the Pacific during each northern winter is in itself an indication that the rare Niño phenomena merely represent an increase in intensity of conditions that prevail annually. Professor Schott marshals his data well for a fundamental explanation. He charts the normal stream axes and borders of the Humboldt and equatorial countercurrents for typical periods of August-September and February-March, and for March, 1891. The oceanographic circumstances may then be seen to accord with the meteorological background for each period.

The meteorological equator, as measured by pressure, wind, and precipitation (not by temperature) runs east-southeast toward the South American coast, which it meets near Panama during the northern summer and at the geographic equator during the winter. In summer a rain-bearing southwest monsoon replaces the east-southeast trade winds in the Cocos-Malpelo-Buenaventura-Balboa region. In winter the northeast trades blow as northerly winds over the Gulf of Panama and almost down to the equator. When the low pressure belt is drawn south of its normal seasonal position, the southeast trades are replaced by rainy northerly to northwesterly winds, forcing warm surface water southward. A belt of lowest pressure, representing the meteorological equator and reaching the mainland between 6° and 10° S. was a constant factor during the Niño advance of 1925.

The dislocation of the meteorological equator, involving the shifting of the equatorial calm belt with its cloud-bursts, thunderstorms, and northerly monsoons two to three hundred miles southward, sufficiently indicates that the Niño results from a widespread atmospheric disturbance. Similar conditions along the West African coast, modified by the absence there of a high mountain system to deflect the trade winds, serve to give "Niño" a generic meaning in geography. Furthermore, the oscillations of the meteorological equator on the west coast of America have clear

analogues in annual conditions during the synchronous northwest monsoon season in the Malay Archipelago and northern Australia.

Professor Schott has removed the uncertainty from many problems concerned with the irregular rhythms of Humboldt and Niño currents. The significance of the long-term periodicity does not come within the scope of the present study. As regards the "normal" régime in the coastal waters between Talcahuano and the Gulf of Guayaquil, more detailed and illuminating data may now be expected, for during the southern winter of 1931 the British Royal Research ship *William Scoresby* made eleven exhaustive cross sections.

R. C. MURPHY

The Loma Formation of the West Coast Desert. The fog belt zone of the coastal desert of Chile and Peru exhibits one of the most distinctive plant associations in South America, the Loma Formation. In places it appears as a continuous zone, the so-called fertile belt. It is, for instance, well represented north of Paposo (25° S.) where high coastal ridges narrowly concentrate the moisture. Farther north on the Chilean coast the distribution is discontinuous but interesting because of the simplicity of the factors involved: "the relation of fog to the presence of vegetation is here most obvious." The meager flora of this "Nitrate Coast" is known only as it is developed about the ports of Antofagasta, Tocopilla, and Iquique, and the abandoned port of Cobija; but an idea of the general extent of the vegetation here can be gained from the distribution of the striking columnar cactus (*Cereus iquiquensis*). Mr. Ivan M. Johnston, who collected in the area in 1925, a favorable year on account of the exceptional rains, describes the flora of the nitrate coast as floristically closer to that of Atacama rather than Peru, a characteristic perhaps related to the change in coastal topography just south of Arica (Papers on the Flora of Northern Chile, *Contribs. from the Gray Herbarium of Harvard Univ.*, No. 85, 1929, pp. 1–172).

In the same year while engaged in ornithological study Dr. Robert Cushman Murphy took the opportunity of collecting plants from the islands off the Peruvian coast. Mr. Johnston also describes these (Vascular Flora of the Guano Islands of Peru, *ibid.*, No. 95, 1931, pp. 26–35). The only Peruvian islands on which higher plants are represented are Lobos de Tierra, San Lorenzo, San Gallan, and Viejas. Lobos de Tierra, a low island off the northern coast (6° 26′ S.) owes its "pitifully small" vegetation to the occasional visits of equatorial storms. There are only two species—a halophyte (*Sesuvium*) is one, and the other is represented by a single specimen, a thorny acacia-like tree (*Prosopis*). The other islands owe their vegetation to their altitude, which brings them into the fog belt here occurring at an altitude of 300 to 400 meters. On the guano island of San Gallan Dr. Murphy found seventeen species of ferns and flowering plants; three of these species also occurred on the summit of Viejas. The flora of the islands is apparently an impoverished fragment of the Loma Formation of the mainland.

AUSTRALASIA AND OCEANIA

Physiography of the Western MacDonnell Ranges. In Central Australia, near Alice Springs and extending mainly westward, is an important series of mountain ranges called the MacDonnell Ranges. They are of particular economic importance because of pastoral developments in the most favorable localities. A geological reconnaissance made in 1930 by C. T. Madigan, the last of three expeditions by the author, was reported in a recent issue of the *Geographical Journal* (The Physiography of the Western MacDonnell Ranges, Central Australia, *Geogr. Journ.*, Vol. 78, 1931, pp. 417–433). An aerial reconnaissance, made in 1929 (compare Fig. 1, p. 418, and author's previous article, *Geogr. Journ.*, Vol. 76, 1930; also *Geogr. Rev.*, Vol. 21, 1931, p. 164), was designed to explore the western part of the ranges and the great salt lakes of the southeastern part of Central Australia. The last expedition was by

camel caravan to secure detailed ground observations. Among the results of the three expeditions is a somewhat detailed map, a significant advance over earlier maps of the region.

"The MacDonnell Ranges form a remarkable feature, a narrow east-and-west mass of high mountains, up to 5000 feet, rising out of desert plains. They cover an area about 250 miles long, east and west, by 20 miles wide, extending westerly from Alice Springs some 160 miles and easterly 90 miles. To the west they run in a series of remarkably narrow, high, and continuous parallel ridges, with flat and comparatively level narrow plains between. The ridges are all of quartzite, the valleys or plains representing limestone or slate beds. The most novel feature about these ridges is that they are absolutely uncrossable, even on foot, for distances of 30 miles or more, but they are intersected at right angles by the streams which pass through them in steep gorges known as gaps, which are now mostly named" (p. 422).

East of Alice Springs the ranges are "much more broken up," trend northeasterly, and are without the regular arrangement of the ranges farther west. The most conspicuous ridge is the Heavitree Range. It contains most of the high peaks of the region and is the outcrop of an eroded anticlinal fold which pitches west and is gaping to the east, the opposite limb of the fold constituting the Chewings Range. Adjacent ridges, also of quartzite, run parallel to the Heavitree Range and to each other for over one hundred miles "in a most extraordinarily regular formation." The plains between the ridges are filled synclinal troughs. The whole of the MacDonnell Range is an ancient geosyncline. The rivers are of great antiquity and are said to be excellent examples of antecedent rivers, following old southerly drainage directions and cutting through the great 1000-foot ridges at right angles. (In this connection see W. M. Davis: Physiographic Contrasts, East and West, *Scientific Monthly*, Vol. 30, 1930, pp. 395–415 and 501–519; specifically, "Antecedent Rivers," p. 406.) There are valuable observations on geological structure and rock types, and the paper closes with a section on the use of the aneroid.

Crops of Coastal Queensland. In the third number of the *Australian Geographer* (Vol. 1, Part 3, May, 1931) is a paper by John Andrews, "Tropical and Sub-Tropical Agriculture in Coastal Queensland" (pp. 62–68), containing two interesting graphs. One shows the variation of land utilization with latitude on the Queensland coast. Maize, fodder, hay, bananas, and pineapple, important on the southern border of the state (latitude 27° S.), all decline to insignificance at the tropic where the almost exclusive monopoly of sugar cane is established. Cotton has a maximum at about 22° with a secondary center at 18°. The second graph shows acreage of subtropical crops—cane, bananas, pineapple, and cotton—under cultivation since 1860. From the first establishment the first three named show a generally steady progress that augurs well for the future. In Queensland there is a marked specialization by areas, the main agricultural regions of the coast being a series of basins connected only by the coastal railroad. Cane, the outstanding of the warm-zone crops, is confined pretty definitely to river valleys of the coast with good soils. The most-favored areas are those where good soil coincides with heavy rainfall, notably in the neighborhood of Mackay with over 70 inches of rain and about Cairns with a maximum of 160 inches.

Pineapple, contrary to experience elsewhere, seems to do best where the rainfall is relatively small, as in the neighborhood of Brisbane, where temperature also is relatively low. A pineapple-canning industry has recently been established. In 1928 the value of the crop was nearly a quarter of a million pounds, the banana crop was not far short of a million, sugar cane more than seven million. In forecasting the future it must be remembered, however, that cane is still grown under "artificial" economic conditions—with the aid of bounties and monopolies.

Cotton production exhibits enormous fluctuations. It is not that the crop suffers

climatic disabilities, for, as Griffith Taylor has shown, broad areas from Sydney to Rockhampton present similar climatic conditions to the United States of America, while northward conditions are comparable with Indian cotton areas; nor are markets wanting. But the crop grown in a young country, with high production costs, low yield, white labor, and poorly organized marketing and distributing facilities, cannot compete with the older producing areas of the world. "The future of cotton, as of many other tropical crops, e. g., coffee, and, of the greater part of our tropical agricultural lands seems to depend rather more upon politics than upon geographic factors."

POLAR REGIONS

Relation of the Work of the Mawson and Norwegian Antarctic Expeditions, 1930–1931. As indicated in these pages last year (*Geogr. Rev.*, Vol. 21, 1931, pp. 326–328) the field of operations of the Mawson Antarctic expedition of 1930–1931 coincided with that of the Norwegian explorations of the same season in the coastal belt of the continent between 82° and 61° E. Mawson's vessel the *Discovery* proceeded westward through this area between February 7 and February 19, 1931. According to a manuscript track chart supplied to the American Geographical Society by Major Gunnar Isachsen a number of Norwegian whaling vessels traversed a part or the whole of the belt both earlier and simultaneously. Somewhat distant from the coast were the tracks of the motor tanker *Thorshavn* (westward, January 31–February 6) and of the floating factories *Antarctic* (eastward and westward, February 15–25) and *Thorshammer* (westward, February 8–15), whereas the chasers *Bouvet 2* (eastward, January 19) and *Torlyn* (westward, February 12–15) followed the shore at close range. The course of the *Thorshammer* after February 12 is shown on the inset map of Plate I in this issue, that of the *Thorshavn* on the accompanying text map (Fig. 1), and that of the *Torlyn* on both.

Although the route of the Mawson expedition and the outline of the features it discovered cannot be laid down with precision until the report of the expedition appears (see above, p. 94, footnote 7), the last in the series of wireless messages sent from the field by Sir Douglas, and especially his two summaries of the work of the expedition (*New York Times*, March 20 and June 28, 1931), together with Major Isachsen's account in the present number, enable one to visualize the relation in time and place of the British and Norwegian expeditions and to clarify the points that were still obscure when the previous account in these pages (Vol. 21, 1931, pp. 327–328) was written. The accompanying Figure 1 attempts to present this relation and to differentiate by means of the style of lettering between the names given by Mawson and those given by the Norwegians to the newly discovered features. Being oriented in the same manner, Figure 1 may be directly compared with the inset map on Plate I for greater topographical detail and for the farthest advanced positions of earlier expeditions.

After having proceeded westward roughly along the 65th parallel from 88° to 82° E. Mawson's vessel set a southwestward course, being in 66° S. and 78° E. at 4 p. m. on February 8 and in 67° 15′ S. and 74° 20′ E. on February 10 (probably at noon). Between these two positions, from a point in 66½° S. and 76° E., an airplane flight was made on February 9 to an altitude of 5200 feet. Away to the east-southeast an extensive area of grounded bergs was observed beyond which an ice-covered land could be seen extending as a faint line on the horizon from southwest to southeast. In a later summarizing despatch (*New York Times*, March 20, 1931) Sir Douglas describes the land as commencing at a point in 66° S. and 80° E. and extending south and west in a great sweep to a cape in 68° 21′ S. and 72° 20′ E. that he named Cape Amery. This 250-mile long stretch of coast was named Princess Elizabeth Land after the elder child of the Duke and Duchess of York. The eastern part of this coast, between which and Kaiser Wilhelm II Land of the Gauss expedition farther

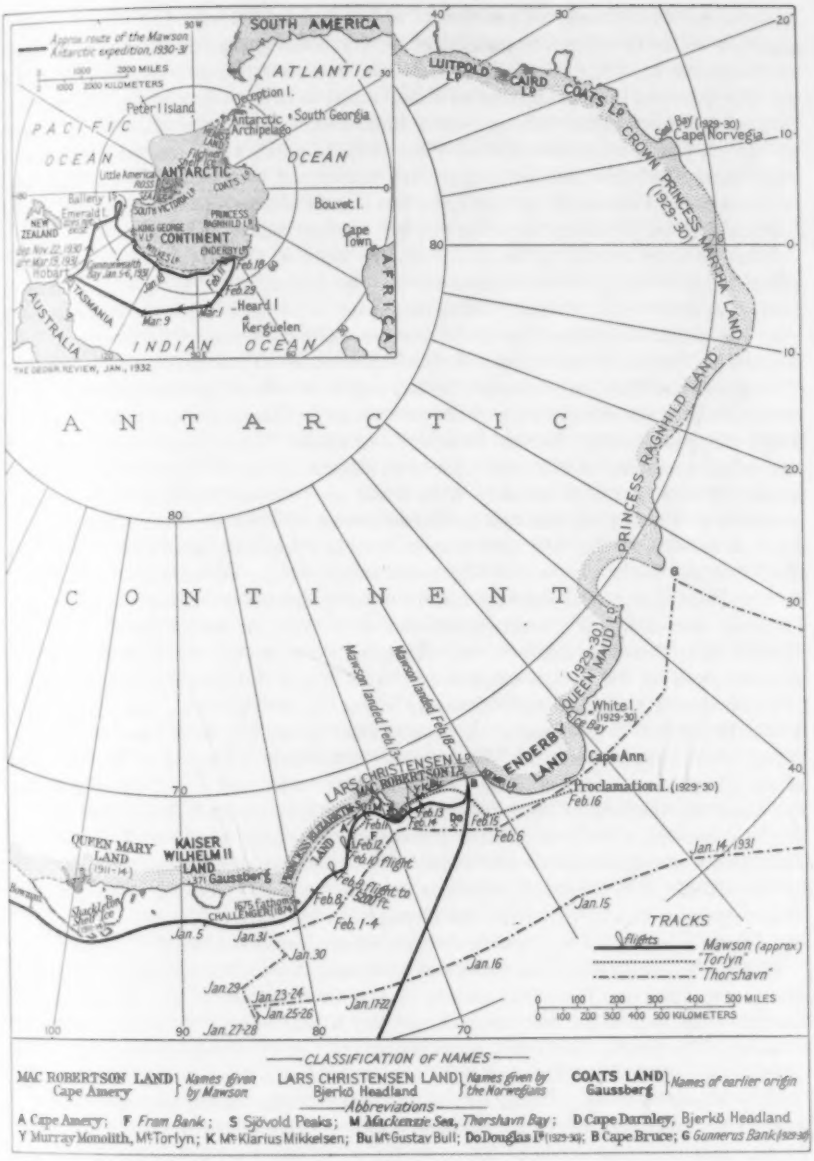


FIG. 1.—Map showing the overlapping routes of the Mawson and Norwegian expeditions of 1930–1931 to the Antarctic. Scale 1 : 30,000,000. The names given to the newly discovered features are differentiated according to their origin. For further details of the Norwegian work see the inset map of Plate I in this issue. The entire route of the Mawson expedition is shown on the inset above.

east a gap of only 150 miles remains unknown, does not seem to have been observed by the Norwegians. But on January 25, when the volcanic Sjövold Peaks were first sighted by her captain, the chaser *Bouvet 3* had already been in 68° S. and 74° E., a point off the western part of this coast 45 miles northeast of the assigned position of Cape Amery and possibly only 20–30 miles from land. With regard to the eastern part of the coast it may be stated in this connection that the land may not jut out

quite as far as the reported position of 66° S. and 80° E. would call for, inasmuch as this is within 17 miles of a sounding of 1675 fathoms (3063 meters) of the *Challenger* on February 14, 1874 (Challenger Reports: Summary, First Part, London, 1895, pp. 495–496) and it would appear as if land could have been seen in the clear weather prevailing on her farther course thence southward to her farthest in 66° 43′ S. and 78° 22′ E. (*ibid.*, Narrative, Vol. 1, First Part, London, 1885, pp. 348–401). However, except for this possibly exaggerated northward projection, the implied trend of the coast of Princess Elizabeth Land fits in well with the course of the *Challenger* between the 1675-fathom sounding and her farthest south position.

West of Cape Amery as far as 61° E. the work of the Mawson and Norwegian expeditions overlapped almost constantly. On February 11 (a flight was made on that day) and 12 the *Discovery* followed around the shores of a large bay and sailed past the promontory that lies at its northwestern entrance. The bay was named Mackenzie Bay after the captain of the *Discovery*, and the headland Cape Darnley. Two days later the *Torlyn* circled the bay and promontory, and a Norwegian party went ashore at the eastern base of the promontory. The bay was named Thorshavn Bay, the promontory Bjerkö Headland. Beyond Cape Darnley the *Discovery* continued westward on February 13 and 14 along the stretch of coast that lies about along the 68th parallel; landings were made on February 13 at two of its rocky headlands. From a photograph published in the *Daily News*, New York, June 28, 1931, it is obvious that the rock named Murray Monolith by Mawson is the Mt. Torlyn appearing in Figure 2 of Major Isachsen's article above. The Mt. Mikkelsen of the Norwegians also appears on the photographs but without being named; however, the reference without statement of location in one of the despatches to Scullin Monolith may apply to this feature. This stretch of coast was followed and surveyed by the *Torlyn* a day after the *Discovery* had passed. It is this survey that disclosed its position approximately along the 68th parallel. This is the MacRobertson Land of Mawson's 1929–1930 expedition, but he then represented it (*Geogr. Rev.*, Vol. 20, 1930, Pl. VI) some 60–70 miles too far north, as he now recognizes. On this point he says (*New York Times*, March 20, 1931): "When MacRobertson Land was discovered last year it was beset with heavy pack ice, so that portions of the coast line were located from the plane at a distance. We now find that in most cases the distances to the coast were underestimated owing to the clarity of the air and the wonderful visibility in these regions." Owing to the fact that they determined its true position the Norwegians have given it a name of their own, viz. Lars Christensen Land, which they consider to extend from 75° to 60° E.

Mawson's paralleling of the coast was interrupted by an easterly gale which forced him to put out to sea from February 15 to 17. On February 18 the vessel was again turned south, and in the afternoon of that day a landing was made in a cove in the shelf-ice cliff where a small rocky point protruded. At this point (in about 61½° E.), which was named Cape Bruce, a cairn was erected and the British flag was raised. To the west the coast, formed by the cliff face of the inland ice, interrupted by minor rock exposures, could be traced as it swung north to merge into that of Kemp Land. Into this inner recess of the coast at Cape Bruce the Norwegians do not seem to have penetrated, the tracks of the *Torlyn* and of the *Bouvet 2* swinging across the bight on their way to or from the rounding of Enderby Land.

Shortage of coal now made it necessary for the Mawson expedition to return. Cape Bruce was left on February 19 and the course set for the southward extension of the submarine Kerguelen-Gaussberg Ridge (see Pl. I) that had been disclosed the previous year by the low sounding of 350 fathoms (640 meters) in 59° 10′ S. and 77° 45′ E. (*Geogr. Rev.*, Vol. 20, 1930, p. 541). Further soundings were made which more clearly defined the ridge. Continuing approximately on the course indicated in Figure 1 Hobart, Tasmania, was reached on March 19, and the expedition came to a close.

Novaya Zemlya and Franz Josef Land. Material relating to these islands in particular, and of interest for Arctic geography and oceanography in general, is contained in the following recent publications (in Russian) of the Institute for Study of the North: No. 40, "Novaya Zemlya," Moscow, 1929; No. 47, "Zemlya Frantsa Iosifa," Moscow, 1930; No. 49, "Nauchnye rezultaty ekspeditsii na Zemlyu Frantsa Iosifa letom 1929 g." (Scientific Results of the Expedition to Franz Josef Land in the Summer of 1929), Moscow, 1931. Each consists of a collection of articles by various specialists on different subjects.

The studies of Novaya Zemlya were made in the course of expeditions in 1921, 1923, 1924, 1925 (round the two islands), and 1927, under the leadership of R. L. Samoilovich, who provides a spirited introductory narrative profusely illustrated by photographs and accompanied by a summary in English. The expeditions were confined to the coasts, except for a week's trip, in 1923, up the Bezymyannaya (Nameless) River, on the western side of the southern island, which penetrated more than thirty kilometers into the interior. A handsome map (1 : 84,000), constructed from observations made on this trip, is appended to the volume, one of fifteen in general and detail. Numerous inaccuracies found in previous charts of the coasts have been corrected in the main general map, 49 by 36 centimeters.

Evidences of uplift were found at many points along the shores, in the form of marine terraces, four in number where best developed; driftwood and sand banks well above present high-water marks; and quaternary shells observed at one point 10 meters above sea level. The uplift is accompanied by powerful wave erosion along the shore line, favored by the prevalence of violent winds, the slight tidal variations of water line, and the friable nature of the rock formations. Deposit of the products of this erosion results in a rapid extension of the shore line through the building of spits, the closing of bays and straits, and the junction of outlying rocks and islets to the main islands. M. M. Ermolaev, who contributes a scholarly article on the influence of wave action expressed in elaborate formulae, estimates the resulting extension of area as proceeding at a rate 80 times as fast as the vertical uplift of the land.

There is apparently no extensive ice cap, but glaciers, often reaching the coast, are numerous, except in the extreme northern part. One investigated at Comfort Bay, on the east coast of the northern island, showed clear indications of recession. Rivers flowing from inland glaciers reach the coast either directly through canyons or emptying into broad bays which offer numerous harbors. As a result of the wave action described above, these bays are commonly intersected by bars and spits, forming lagoons, and the upper part is sometimes completely cut off as a relict lake.

The economic resources of Novaya Zemlya are not considerable. No important minerals are known to exist. Coal fragments in alluvial or glacial deposits were encountered in several places, but beds of practical importance have not been located. The types of soil found were rudimentary, showing on the higher surfaces only humus sparsely developed around the roots of plants, although on the south shore of Krestovaya Bay a layer some 35 centimeters thick was encountered, and luxuriant vegetation was observed on the southerly exposure of the interior valley penetrated in 1923. Reindeer are plentiful, their tracks having been seen at the extreme northern point of the land, and there are several fur-bearing animals, including the Arctic fox. The most substantial present support of the few Samoyeds who inhabit the land is the fishing of *golets*, a type of landlocked salmon identified by Samoilovich with *Salmo alpinus*.

The principal object of the 1929 expedition of the ice breaker *Sedov* to Franz Josef Land was the establishment of the permanent station for meteorological and other studies on Hooker Island. Various investigations by special groups were made in the course of the expedition's stay. The geological party was headed by Samoilo-

vich, who contributes a general sketch based on the studies of previous investigators, in publication No. 47, and an article on the data gathered by this expedition, in collaboration with I. M. Ivanov, who also writes on soils, in No. 49. The rock formations observed were basalt underlain by sandstones which contain plant impressions and fragments of petrified wood apparently of Upper Jurassic series. Coal fragments are of common occurrence; and lignite beds are known on Northbrook (Cape Flora) and other islands. Clearly defined marine terraces, three or four in number, with the highest 25–30 meters above sea level, were noted at different points. Only the coarsest tundra-podzol types of soil can be formed under the conditions offered, with a temperature slightly above zero centigrade during only one month of the year, thawing the ground to a depth of 25 centimeters or less. The prevailing vegetation is moss, with rare flowering plants.

Most of the surface of the islands is covered by caps of highland ice obscuring almost all relief. There are indications, however, that glaciation is less extensive than in the past. In many places the ice does not reach the sea, stopping short of the edge of the plateau, while in other places the shore ice has lost its connection with the main cap through the protrusion of shoulders of the plateau, converting it into "dead glaciers."

An important aspect of the 1925, 1927, and 1929 expeditions was the execution of hydrological studies of the northern seas. Among the results may be mentioned confirmation of the existence of a branch of the Atlantic Current in Whitney Bay, on the northeastern coast of Novaya Zemlya, and of another branch in the Queen Victoria Sea, northwest of Franz Josef Land. The latter was found by the observations of W. Wiese and A. Laktionov nearly due east of the southern end of the supposed location of Alfred Harmsworth Island, a position making its course difficult to account for, given the island's existence at the spot assigned it by Jackson in 1897. On two passages north and south the island was not sighted from the *Sedov*, although Arthur Island, to the south of its location, was clearly observed. The island was not seen by the *Graf Zeppelin* nor the *Malygin* (1931).

Notes on work done in Franz Josef Land, Severnaya Zemlya, Novaya Zemlya, and other parts of the "Soviet Arctic" are to be found in the *Bulletin of the Arctic Institute* (in Russian with English summaries, Leningrad, 1931), organ of the newly reorganized Institute of the North of which the first issue appeared early in 1931. An account of the 1931 cruise of the *Malygin* to Franz Josef Land and Novaya Zemlya is contained in Number 8.

J. V. FULLER

The Wilkins-Ellsworth Transarctic Submarine Expedition. The American Geographical Society has received the following communication from Sir Hubert Wilkins regarding the Wilkins-Ellsworth Transarctic Submarine Expedition.

The expedition, while unable to carry out its full program as the result of a series of setbacks, returned with new and interesting results in the various departments of science represented. Delayed by defective machinery, which failed to function in temperate latitudes but which did eventually work in the Arctic, the *Nautilus* was unable to leave her base in Spitsbergen, Longyear City, until August 18; and only three weeks were spent in the pack ice. For five days during that period work was further delayed by a violent storm, during which the submarine safely maneuvered at the edge of the pack—the most dangerous position for a vessel of its type.

The weather throughout would have made oceanographical work on an ordinary surface vessel most uncomfortable and at times impossible; but, by operating through the hinged door at the bottom of the "diving compartment" (a compartment which by developing air pressure could be converted into a diving bell), the scientists under the direction of Dr. H. U. Sverdrup made observations at ten oceanographical stations, collecting among other things core samples totaling more than 18 feet of deposits from the deep ocean floor. The longest core in one sample measured 23

inches. A curiosity among these samples included a crumbly deposit at the bottom. It is possible that the plunger had been forced through a layer impervious to water and that beneath that layer the moisture had been forced out by pressure.

It was found possible, even though the door of the compartment was 15 feet below the surface and the weather at all times cloudy, to see the instruments clearly when they were still 80 feet below sea level. Bottom samples, a series of 18 water samples, temperatures to depths of more than 2000 fathoms, and hauls of plankton from 100 fathoms were taken with accuracy and success in half the time usually spent in such operations from the deck.

While the oceanographers were busy, Dr. Villinger in charge of the gravity machine could use his instrument and took eight readings of the pendulum action in uninterrupted runs of half an hour and more.

The fathometer was used to depths of more than 2000 fathoms with success, and by means of it a ridge hitherto unsuspected was located at 25 fathoms some distance north of Northeast Land. Another interesting discovery with the fathometer was a group of ridges running west from Spitsbergen. An attempt to follow them toward Greenland was curtailed by stiff pack ice and the lateness of the season.

A short series of magnetic observations was obtained, and a collection of birds was made for the Cleveland Museum of Natural History. It was found that the temperatures and conditions encountered would not interfere with the functioning of a submarine in Arctic waters, and experiments with various means of insulation showed that difficulties expected from condensation within the vessel might be easily overcome.

The loss of the diving rudders from the submarine soon after the expedition had reached the ice made it impossible to travel far beneath the floes, but the *Nautilus* working in an "awash" condition was several times forced beneath the ice. In that manner the expedition was able to gather the first practical data of conditions under the ice and proved that a vessel can be operated there with safety.

In fact, every theory advanced before the expedition started was proved to be sound. The scientific material now being worked up at the Woods Hole Oceanographic Institution, the Carnegie Institution of Washington, the Norwegian Geophysical Institute, and by Dr. Villinger and Dr. Vening Meinesz will soon be ready for publication.

THE OCEANS

Arctic Ice and Its Distribution in the North Atlantic Ocean. The object of the International Ice Patrol, whose work is carried out by the U. S. Coast Guard, is to locate the icebergs menacing the North Atlantic steamship lanes. In connection with this, it has been found necessary to carry on a program of oceanographic research for the purpose of solving two practical problems, namely, the forecasting of the number of bergs that are likely to come down and the forecasting of their movements on arrival at the critical area in the vicinity of the tail of the Grand Banks. In pursuance of this research the Coast Guard cutter *Marion*, under the command of Lieutenant Commander Edward H. Smith, was sent in the summer of 1928 to make an ice and current survey of the waters between North America and Greenland from the latitude of St. Johns, Newfoundland, to the mouth of Baffin Bay.

In the first volume of the scientific results of this expedition to appear (The Marion Expedition to Davis Strait and Baffin Bay under Direction of the United States Coast Guard 1928: Scientific Results, Part 3, Arctic Ice, with Special Reference to Its Distribution to the North Atlantic Ocean, *U. S. Treasury Dept., Coast Guard Bull. No. 19*, Washington, 1931) Commander Smith presents a comprehensive account of the various factors involved in the formation of land and sea ice in the Arctic and its subsequent distribution in the North Atlantic. In addition to giving an admirable discussion of ice in the Arctic and a detailed description of its occurrence

in the different regions, Commander Smith takes the opportunity to summarize existing knowledge with respect to the problems involved in the formation of ice and icebergs, so that this publication furnishes the latest information on these matters. An extended bibliography and an index further add to its value.

The drift and fate of icebergs in the North Atlantic is under the control of wind and current. Bulky, full-contoured bergs, because of the large mass under water, are moved but little by the wind and follow the course of the current. The chief highway for the Arctic ice to lower latitudes is along the coasts of Labrador and Newfoundland. Occasionally icebergs survive for relatively long periods of time, even when floating in Atlantic Ocean water of high temperature, and they may then make phenomenal journeys. Thus icebergs have been sighted near the Azores, near the British Isles, and even near Bermuda. But as Commander Smith points out, such drifts do not indicate an extension of the Labrador Current into these regions; they mean merely that the bergs in question were caught in an oceanic eddy such as accompanies the movement of large masses of water in an ocean basin. The drift of icebergs into such low latitudes is quite unusual, the fortieth parallel of latitude being ordinarily the limit of iceberg drift.

Of special interest is the discussion of the effect of northern ice on the temperature and circulation of the waters of the North Atlantic. Otto Pettersson has advanced the theory that in the melting of ice is to be found the main energizing agent responsible for the circulation of the waters in the North Atlantic. But, as Smith shows, the energizing forces resulting from melting ice are not adequate to bring about the circulatory mechanism of the ocean. He finds that "the chilling of the northwestern North Atlantic as a result of ice amounts to approximately one-half the solar heating this same region receives during the summer." Furthermore, "the cooling effect of ice melting amounts to only ten per cent of the total cooling that the Atlantic receives from the cold water masses of the Labrador Current." And he concludes that "the major controls of the thermal equilibrium of the North Atlantic Ocean are the ocean currents, while the direct action of vernal warming in the ice areas themselves, and the opposite effect of chilling by Arctic ice, are secondary."

H. A. MARMER

HUMAN GEOGRAPHY

The Probable Origin of Alphabetic Writing. In 1904 Sir Flinders Petrie discovered on the Sinai Peninsula certain inscriptions that have aroused widespread discussion among philologists. Professor Sprengling, in a new interpretation, has shown that these inscriptions were the work of Semitic miners (Martin Sprengling: The Alphabet: Its Rise and Development From the Sinai Inscriptions, *Univ. of Chicago, Oriental Inst. Communications No. 12*, Chicago, 1931). During the reigns of Sesostris III (1887–1849 B. C.) and Amenemhet III (1849–1801 B. C.) the Egyptians were conducting active mining operations in Sinai. Egyptian scribes and overseers were undoubtedly on the spot, but the actual work was carried out by native Semites under native foremen, to whose ingenuity Sprengling ascribes the invention of alphabetic writing. In their alphabet use was made in part of Egyptian symbols, and, like many another great discovery, alphabetic writing would thus appear to have sprung from direct contact between peoples of two distinctive cultures.

From this source the alphabet seems at the outset to have spread in three directions and in the process to have assumed three distinctive forms: South Arabic, Aramaic, and Canaanite-Phoenician. The first became the script of southern and western Arabia and of Abyssinia. The second made its way into the Tigris-Euphrates lowlands and Persia and penetrated thence to India. The Canaanite-Phoenician form became established along the eastern fringe of the Mediterranean. From the Aramaic arose the Hebrew and North Arabic alphabets, and with the conquests of Islam the latter was carried throughout the immense tracts we now know as

the Mohammedan World. Even before the time of Mohammed, however, north Arabic had almost "completely wiped out [South Arabic] in the Arabian peninsula, leaving to the spoken language only a few islands off the southeastern coast and to the script only the forlorn outpost of Abyssinia." The Greek and its derivative, the Russian, alphabets—as well as the Latin, which today seems to be approaching world conquest—all sprang ultimately from the Canaanite-Phoenician form. Dr. Sprengling gives a spirited account of the spread of alphabetic writing from its probable fountainhead in the obscure mining communities of Sinai and illustrates on the three maps the channels followed by this great movement.

Forest Resources of the World. "How long can the world's forests supply the demand for timber and lumber is the anxious question which has arisen in countries importing large amounts of lumber and wood-working products." A Finnish contribution towards the answer takes the form of a survey of the "Forest Resources of the World" (*Communicationes ex Instituto Quaestionum Forestalium Finlandiae Editae 16*, Helsingfors, 1930; in Finnish with English summary). The authors, Lauri Ilvessalo and Matti Jalava, point out that while the necessary statistical data are wanting or imperfect from many regions a good deal of information has been accumulated since the appearance of Zon and Sparhawk's "Forest Resources of the World" (1923), heretofore the most complete treatise on the subject.

In the Finnish volume most space—about five-eighths—is devoted to Europe. Special mention should be made of the sections on Sweden, for which a large body of diverse material was available from the forestry survey begun in 1923, and on Finland, where a survey of forests was made in 1921–1924, and of forest consumption in 1927–1929, whence the information is probably "more complete, diverse, and exact than that of any other country in the world." The importance of the forest in Finnish economy is well brought out in the graphs showing the exports of sawn wood, 1856–1929, and of pulp, cardboard, and paper, 1881–1929.

In conclusion the authors observe that no indications have yet been found that wood consumption has reached its limits as has sometimes been said. The consumption of a few kinds of wood products, such as sawmill products in the United States of America, has somewhat diminished per capita; but, even if permanent, such decline is more than offset by the great increase in consumption of other kinds of wood products. The world's accessible forests are not inexhaustible. "If the world's future demand for wood is going to be filled, rational forest care and cultivation must replace the present wasteful use of the forests so that a yearly harvest can be reaped from them just as from the grain fields."

GEOGRAPHICAL NEWS

Geography at the British Association Centenary Meeting. The British Association for the Advancement of Science held its annual meeting in London in September (23–30). The meeting marked the centenary of the Association, and for this reason perspective and retrospect were featured in notable addresses and in publications prepared for distribution to the members; and with equal appropriateness the address of the president of the Association, General Jan Christiaan Smuts, eminent soldier-diplomat-scientist, was on the subject "The Scientific World Picture of Today."

The picture for geography was presented by Dr. Hugh Robert Mill in an instructive and interesting paper on "Geography at the British Association: A Retrospect." Geology and geography have had a part in the Association meetings from its inception. The first address at the first meeting, in York in 1831, was on the more noteworthy geological features of Yorkshire. Sir Roderick Murchison, who took a leading part in the foundation of the Royal Geographical Society in 1830 and of the British Association in the succeeding year, was largely responsible for the creation of Sec-

tion C, "Geology and Geography," when the four informal committees of the Association were organized as sections in 1834. The gradual development of the conception of geography may be traced in part in renaming the section "Geology and Physical Geography," 1838–1850, in divorcing geography from geology and uniting it with ethnology in a new Section E, 1851–1868, and in separating it from other sciences with the simple designation "Geography" since 1869. In earlier years the presidents of the section were usually surveyors, cartographers, and explorers, whereas recently they have principally been university teachers of geography or officials of the Royal Geographical Society. Many of the early meetings of the section were addressed by men like Livingstone, Speke, Stanley, and Burton, whose names constituted a principal drawing card at the Association meetings for a period of years.

Sir Halford Mackinder's presidential address to the geography section on "The Human Habitat" proposed, as the basis of finding the "fundamental unity [in geography] which eludes us," the study of the hydrosphere rather than the lithosphere or the atmosphere—the geographical study of the distribution of water as the essential common constituent of the "myriad separate bloods and saps" of the living envelope of the earth, being concerned with "water, sap, and blood, moving under sun power and life initiative." (The papers by Dr. Mill and Sir Halford Mackinder appear in the November, 1931, number of the *Scottish Geographical Magazine*.)

The geography of London and vicinity was presented in a paper by Mrs. H. Ormsby on "The Geographical Factor in the Growth of London as Shown by Population Maps Based on Early and Recent Census Figures" and a paper by Dr. S. W. Wooldridge on "The Geomorphology of the London Basin," supplemented by excursions (which are mentioned later). Geography of the dominions was represented by papers by Professor J. H. Wellington on "Land Utilisation in South Africa," by Dr. C. Fenner on "The Structural and Human Geography of South Australia," and by Mr. L. J. Burpee on "The Geography of Canada." Sir John Russell, president of the section on Agriculture, addressed the geography section on "Soil Resources of the Empire: A Suggested Survey."

"The Geographer's Aid in Nation-Planning" was the subject of a paper by Professor Griffith Taylor, with illustrations taken from Australia. Professor W. Werenskiöld dealt with "Variations of Glaciers and Climate in Norway." Dr. Vaughan Cornish proposed the creation of "The National Park of Northumberland, a Shrine for Hadrian's Wall." In cartography, a paper by Brigadier Winterbotham was read which presented the program of the Ordnance Survey in preparing a series of special purpose maps of Great Britain. The only paper listed jointly with another section was that by Lord Lugard, on "Africa in Transition," which was jointly scheduled with Anthropology. A day was devoted to a symposium on "Geographical Problems of the Earth's Crust," with papers by Mr. A. R. Hinks, Dr. G. C. Simpson, Dr. J. H. J. Poole, Professor J. W. Gregory, Professor Arthur Holmes, Dr. Harold Jeffreys, and Dr. de Graaf Hunter, and to a discussion of the papers read. The field of oceanography was the subject of an evening address on the Antarctic by Dr. S. Kemp.

Excursions included a circuit of the City of London, led by Mrs. Ormsby, a tour of the docks and other works under the jurisdiction of the Port of London Authority (jointly with the sections on Economics and Engineering), and an all-day excursion to Romney Marsh led by Sir Halford Mackinder,

In addition to the usual handbooks a second edition of "The British Association for the Advancement of Science: A Retrospect," written by its secretary, Mr. O. J. R. Howarth, and a new volume entitled "London and the Advancement of Science," by various authors, were issued in honor of the centenary meeting and distributed to all who registered.

S. W. Boggs

OBITUARY

Robert DeCourcy Ward. America's great climatologist, Professor Robert De Courcy Ward, died suddenly in Cambridge, Mass., November 12, 1931, at the age of 64. Professor Ward held the only professorship of climatology in the United States, a position which reflected the place he himself had created in the work of Harvard University.

A widely traveled student of the classics, young Ward became interested in meteorology through a course given by Professor W. M. Davis. In 1890 he was appointed laboratory assistant in physical geography and meteorology to Professor Davis under whose direction he made investigations of the sea breeze and New England thunderstorms. This was the beginning of his forty years' continuous service at Harvard.

In 1892 Ward accepted the editorship of the *American Meteorological Journal*, and when, with the popularization of the *Monthly Weather Review*, in 1896 the *American Meteorological Journal* ceased publication, he continued his editorial work by contributing monthly notes on meteorology and climatology to *Science* and to the *Bulletin of the American Geographical Society*. Skilled in reading foreign languages and in writing clear English, Professor Ward performed invaluable service to American geographers by placing before them summaries or reviews of all he considered important in the American and foreign literature of meteorology and climatology. From 1899 to 1931 no less than 673 such notes and reviews were published in the *Bulletin* and in its successor the *Geographical Review*. In addition he contributed 24 major articles to these two journals. Many of these papers he later included in his books "Climate, Considered Especially in Relation to Man" (1908) and "The Climates of the United States" (1925). Altogether some 330 articles and perhaps 2000 notes and reviews in 100 publications at home and abroad are to be credited to his pen. A large number of these contributions dealt with immigration restriction, a subject in which he was an acknowledged leader.

Professor Ward's four books are today the standards in their fields, although two, "Laboratory Exercises in Elementary Meteorology" (1899) and his translation of Hann's "Handbook of Climatology" (1903) have long been out of print. He recently finished the text for North America (except Canada) for the Köppen-Geiger "Handbuch der Klimatologie" in five volumes, now being published. Professor Ward prepared his books with the exacting thoroughness that is attainable only by the devoted editor.

It might be a mistake to regard Professor Ward's writings as his principal contribution to American climatology: his decades of teaching at Harvard and Radcliffe certainly deserve equal emphasis. With him teaching was a passion. Indeed, he said himself that he took such pains with the revision of his lectures that he had little leisure for writing!

Professor Ward believed in personally investigating the climatic regions with which he was concerned. In his youth he spent several years in Europe. Later he circumnavigated South America and traveled widely on that continent as well as in North America. His recent journey round the world gave him longitudinal and latitudinal cross sections of climates that admirably supplemented his American voyages across the climatic belts (Thirty Thousand Miles of Barograph Curves, *Geogr. Rev.*, Vol. 20, 1930, pp. 273–277). Lately Professor Ward entertainingly outlined a guidebook to the world's climates (*Proc. Amer. Philos. Soc.*, Vol. 67, 1928, pp. 67–94).

The personal influence of Professor Ward was far greater than can be indicated in this modest appraisal of his efforts. He was the embodiment of unstinting service to his students and his university, to his colleagues, and to his country.

CHARLES F. BROOKS

GEOGRAPHICAL REVIEWS

Recent Works on Australia

D. B. Copland, edit. **The Economics of Australian Transport.** 231 pp.; map, diagrs., bibliogr. *Econ. Record*, Vol. 6, 1930, Supplement.

D. B. Copland, edit. **An Economic Survey of Australia.** iv and 281 pp.; maps, diagrs., bibliogr., indexes. *Annals Amer. Acad. of Polit. and Soc. Sci.*, Vol. 158, November, 1931.

Edward Shann. **An Economic History of Australia.** xiv and 456 pp.; diagrs., index. University Press, Cambridge, 1930. $6.00. 9 x 6 inches.

Paul Privat-Deschanel. **Océanie.** Maps, diagrs., ills., index. *Géographie Universelle*, Vol. 10, Paris, 1930, pp. 1–284.

Griffith Taylor. **Australia, Including Chapters on New Zealand and Neighboring Islands: A Geography Reader.** xxxii and 440 pp.; maps, diagrs., ills., index. Rand McNally & Co., New York, Chicago, and San Francisco, 1931.

The whole of the August, 1930, number of the *Economic Record* is devoted to "The Economics of Australian Transport," a series of fifteen papers presented to the Australasian Association for the Advancement of Science in May, 1930. A startling conclusion opens the first paper: "that throughout Australia transport services have been provided whose capacity for movement of passengers and freight is greater than the business offering." The returns on the capital of the Interstate Shipping Companies were 2.4 per cent in 1926; 1.6 per cent in 1927, and 0.8 per cent in 1928! The losses on state railways are appalling. The state of sea transport is equally unfortunate. Motor transport also incurs a loss. Yet air transport is stimulated by subsidies. Coördination of transport seems to be the crying need, so that one section of country may not build up facilities regardless of "the scientific position of the other sections." The state governments have built railways on the assumption that there was no limit to the burden that could be supported by the available resources. Political caprice has played fast and loose with long-range policies, and subsidies have encouraged inefficiency, however direct their help may have been in getting rails into areas of new settlement. The papers bring these several items into relationship, show their regional aspects, and tie them to economic theory and proposed remedies.

"An Economic Survey of Australia" is a series of thirty-one papers by fifteen authors, the whole edited by Professor D. B. Copland who also contributes a paper on "The Finance of Industry: Banking and Credit." After a first chapter on the general geography (not, as entitled, "economic geography") there are chapters on population, land use, pastoral industries, dairying, grain-growing, mining, marketing, trade and trade unions, wages, taxes, etc. Naturally a good deal of space is also devoted to the public debt and state enterprises, now in such awkward posture, and to political parties and their economic policies. A final chapter discusses "economic prosperity."

To the author of "An Economic History of Australia" the prospect seems wide—not another United States, to be sure, but the feeder of wool and wheat to Far Eastern markets as well as to Europe and in the end "financial self-reliance," a word of Utopian flavor in the light of the conclusions in the group of papers noted in the paragraph above. The early days are reviewed, days of conquest of land and space.

"Wool-farming," grain-growing, tropical plantations, inland transport—each term connotes a chapter in Australian life associated with enthusiasm and the forward look to greater days to come. Then "a unionism native to the country began to stir," with guerilla warfare and strikes muddying financial waters. "Back to colonizing" is a chapter that traces mining, land use, and labor to their final conclusion: "restriction of settlement and industry to areas and enterprises which . . . provide white Australians with a defined and state-guaranteed standard of living." The last third of the book deals with "The Commonwealth" and the rise of problems dealt with already in the papers in the *Economic Record* cited above.

In Volume 10 of the "Géographie Universelle" are presented "Océanie," by Paul Privat-Deschanel, and "Régions Polaires Australes," by Maurice Zimmermann. The latter has already been discussed in the *Geographical Review* (Vol. 21, 1931, pp. 172–173). Attention is here called to the section on Australia in the first part of the volume. Aside from the conventional data of a regional geography—descriptive material besides statistics, graphs, and maps depicting the environmental elements—there have been presented the distinctive and striking elements of the Australian environment, expressed in a text notable for its readable style despite the condensed treatment. Notices of earlier volumes of this great geography have described the faultless map illustrations, drafted and reproduced in a way that does justice to their clear design. The same care has been bestowed upon the selection of photographs, the ensemble issuing not merely as beautiful books but as the expression of the highest professional standards in geography. To take a single example from the volume in hand, West Australia, one may mention the map of the gold fields (Fig. 35, p. 147), the map of pastoral and agricultural lands (Fig. 37, p. 163), and the photograph of the aqueduct that carries life to the gold fields of Coolgardie and Kalgoorlie (Pl. 29 B, opp. p. 160).

More detailed and intimate descriptions of the Australian environment are found in Griffith Taylor's "Australia: A Geography Reader" (1931). The maps cover much the same ground as those in the "Géographie Universelle," Taylor being the author of a number of the standard maps of the continent published originally in monographs or other original papers. Almost every important aspect of Australian nature or life is discussed and illustrated. There are 240 photographs, maps, and diagrams. The text is enlivened by the author's extensive personal knowledge. Not the least valuable part of his book for the non-Australian student is his emphasis on the history of exploration, summarized in the first chapter and also interwoven with the remaining text. Though designed as a "Reader" the book will be useful to all geographers because of its comprehensiveness and because it is built so largely upon the foundations of Taylor's field work.

Distributional Problems in Agriculture: Eastern Australia

Alfred Rühl. **Das Standortsproblem in der Landwirtschafts-Geographie (Das Neuland Ostaustralien).** 127 pp.; maps. *Veröffentl. Inst. für Meereskunde*, N. F., B. Historisch-volkswirtschaftliche Reihe, No. 6, Berlin, 1929.

Rühl, criticizing the present status of "economic geography"—too much mere description and listing of data—illustrates his arguments by an excellent monograph dealing with eastern Australia. He believes that a new land—not over one hundred years of European or capitalistic development, low density of population, free land still available—exhibits distinctive features and underlying principles more clearly than European regions. The greater part of the monograph deals with the advance and changing aspect of agriculture as settlement drove forward and adjustments were made in the distribution of the various production areas in response (1) to the experimental efforts of settlers in new territory and (2) to world market demands. "All is constant change." One of the most stimulating sections is "The Question

of Crop Production" in which there are discussed the reasons for the departures in crop distributions from the distributions determined by natural conditions alone, such as the habit of the rainfall or the character of the soil—departures enforced by considerations of market, transport, the sequence of harvest periods, associations of crops harvested by certain types of machinery. Rühl traces the causes of mobility in production areas, with illustrations from other countries both old and new. While the bulk of the paper is made up of detailed discussions and applications of great value, chief importance attaches to the introduction, in which the requirements of theory and of scientific analysis are discussed critically, and to the concluding twenty pages in which are discussed the small number of products in a new land, the basis of selection of products, the location or range of given crops as affected by the abundance of cheap land, and the changes that take place as varied crop production comes into a state of equilibrium. If the market demand is substantial a crop of limited range will supplant one of wider distributional possibilities. Some crops have high transportability, others low, owing to differences of perishability and capacity to stand high freight rates. Eastern Australia illustrates each type of displacement as the sheep zone was shifted by cattle, the cattle zone invaded by wheat, wheat by maize, and monoculture by dairying. Severe and widespread drought has repeatedly played a part in causing fluctuations of distribution, because so much of Australia is a climatically marginal land and is profoundly affected by prolonged drought. Sometimes this effect is combined with low world-market demand, at other times not. Conspicuous throughout the paper is the thoroughgoing way in which the economic forces that play upon production and affect its range are skillfully distinguished from the "natural" forces. The whole is a masterly study of especial value to geographers as a demonstration of the necessity of seeing problems in their entirety and not merely examining special phases through the medium of techniques too narrowly conceived.

Three agricultural regions maps in color for three successive periods (1862–1869; 1890–1893; 1916), with other crop distribution maps in chronological series, are in keeping with the author's view of the dynamic nature of economic geography.

A Regional Geography of South Australia

Charles Fenner. **South Australia: A Geographical Study, Structural, Regional and Human.** xvi and 352 pp.; maps, diagrs., ills., glossary, index. Whitcombe & Tombs, Melbourne, 1931. 7s. 6d. 8¾ x 5½ inches.

This valuable book is the most complete regional geography so far published regarding Australia. The author is well known for his researches in the topography and economic geography of the southeastern parts of the continent. The book is based on four recent lengthy memoirs by Dr. Fenner on various aspects of the geography of South Australia but contains a great deal of new matter. There are 23 chapters divided into four parts dealing respectively with Structure and Physiography, Progress of Settlement, Adelaide and Its Environment, and Natural Regions of South Australia.

There is at first an interesting discussion of the evolution of geographical research. Then follows the description of the structure of the state, illustrated as always by Dr. Fenner, by a bountiful supply of block diagrams and sketch maps. Geological sections and fine photographs should make the horst region around Adelaide particularly easy for foreigners to understand.

De Martonne's terms concerning areism are adopted and illustrated by many of the inland river basins. A new term, "cryptoreism" (hidden flow), is suggested for the drainage in the southeast corner of the state. The lower Murray is well described and divided into three structural elements. To these are given the appropriate tribal names Nawait, Murundi, and Narinyeri.

In the economic sections the account of native vegetation (in part based on the work of T. G. Osborn) is very welcome. For instance, we learn that the leaves of the fodder plant "saltbush" absorb a considerable amount of water directly from moisture in the air. The section on soils also adds notably to our very meager knowledge of this subject in Australia. The study of the growth and distribution of population follows rather closely the writer's already published work, but it is handy to have it published in book form.

The section on Adelaide (pp. 214–291) can be confidently recommended to teachers who desire a complete study of a typical Australian center of settlement. In the reviewer's opinion it is the best of its kind in the Commonwealth. Finally, every geographer who desires to understand the criteria for determining a natural region will find much to appreciate in the last section, which discusses this much debated topic. There is one criticism that foreign geographers will make—that very little space is given to the vast area called "Beyond the Counties," comprising three-quarters of the whole state of South Australia. However, the area is of little economic importance; and Dr. Fenner, unlike some writers, has no hesitation in so labeling it.

GRIFFITH TAYLOR

TROPICAL FORESTS

TOM GILL. **Tropical Forests of the Caribbean.** xix and 318 pp.; maps, ills. Tropical Plant Research Foundation, Washington, D. C., 1931. $10.00. 8¾ x 6½ inches.

This attractive and well written book is the result of three years of travel and study in the countries of tropical America north of Brazil undertaken by the Tropical Plant Research Foundation in coöperation with the Charles Lathrop Pack Forestry Trust. It is concerned with the existing forests of those countries and their influence on the timber situation in the United States; also tropical logging methods, problems of tropical enterprise, forest laws, and the progress of forestry. The chapters on the present and potential uses of tropical American woods and on Northern South America were written by William R. Barbour, former forester for Haiti and now forester for Porto Rico and the Virgin Islands.

Four text maps give the distribution of four general forest types, namely the coniferous, deciduous, dry forest, and rain forest. For each country the author discusses the forests, the extent to which they have been exploited, the laws affecting them, and the question of the public attitude toward conservation. Tropical logging methods and some of the hazards that attend enterprise in exploiting tropical forests are fully covered.

The map showing the distribution of the forest types of Central America has been subjected to criticism, particularly with reference to the showing of rain forests on the Pacific Coast and of a large area of coniferous timber in Costa Rica. From the text it is obvious that the coniferous trees are supposed to be pine (*Pinus*). The reviewer has attempted to fix the southern limit of pine in America, and the available evidence indicates that the genus does not extend much if at all beyond the middle of Nicaragua.

An appendix includes a short discussion of the better known broadleaf species in the Caribbean region by family and genus, a list of common and botanical names of trees mentioned in the text, a selected bibliography, and four tables, including a tabulation of the forested areas of the Caribbean region by countries.

Realizing the partial and often unreliable nature of existing knowledge in regard to tropical forests, the author claims no minute degree of accuracy and no final word of authority. In the preface he states: "Writing a book on tropical forests is essentially in the nature of pioneering. It partakes in all the hazards of pioneering, in the absence of guide or precedent, and in the uncertainty of the final results. One

must paint the picture in bold, broad strokes, realizing that many details going to make up the total situation are only imperfectly known. The problem itself is still too incompletely solved to be dealt with in any but the broadest way."

SAMUEL J. RECORD

A JOURNEY THROUGH CENTRAL BRAZIL

OTTO MAULL. **Vom Itatiaya zum Paraguay: Ergebnisse und Erlebnisse einer Forschungsreise durch Mittelbrasilien.** xv and 366 pp.; maps, diagrs., ills., index. Karl W. Hiersemann, Leipzig, 1930. RM. 60. 11½ x 8¼ inches.

In May, 1923, Professor Otto Maull of Graz set out on a voyage to Brazil. The account of this trip now fills the pages of a ponderous volume. The story of the author's experiences and observations is set forth in an interesting and straightforward style, although to some readers the narrative will seem rather lengthy and overdetailed. However, embedded in this mass of detail one keeps turning up fragments of geographical description concerning regions where such information has been seriously lacking.

The author's travels in central Brazil extended over a period of five months. The first chapter describes the voyage across the Atlantic. Then after telling of his arrival in Rio de Janeiro and presenting a number of observations on that city, Professor Maull starts inland to Petropolis. On a trip through the Serra dos Orgãos, the serrated outlines of which are visible from Rio de Janeiro Bay on a clear day, he recognizes on the north slopes what proves to be a widespread erosion level, broken and dissected but nevertheless clearly visible in many parts of the crystalline oldlands of this part of Brazil. Farther north, in the state of Espirito Santo, Professor Maull makes a side trip away from the usual paths of travel into the mountains south of the Rio Doce. The author's attention is again attracted to the problem of erosion levels, and in the mountains of this state he recognizes three. The highest one is between 800 and 1000 meters above the sea, the middle one 600 to 700 meters, and the lower one between 300 and 400 meters. In addition to the geomorphology, however, Professor Maull records numerous observations on the settlement of the area by German, Italian, Polish, and Brazilian colonists. A series of small sketch maps show the arrangement of the fields in several new clearings (*Rodungsoasen*) in the forest, where coffee is the chief crop. He also includes a map of the placing of the buildings on a typical *fazenda*. The usefulness of these maps, unfortunately, is seriously injured by the lack of a scale. He follows the railroad up the Rio Doce into Minas Geraes, noting the characteristic antecedent nature of that river. Along its valley is a very interesting series of terraces preserving a story of physiographic development yet to be worked out. Along the railroad are strung a number of small settlements serving as collecting stations for the coffee raised in the mountains to the south and brought down in two-wheeled oxcarts.

Returning from Espirito Santo, Professor Maull describes the Parahyba Valley and an ascent of Mt. Itatiaya. Note should be made of his analysis of the physiographic history of the capture of the Tieté by the Parahyba and of the formation of the Parahyba graben.

Traveling away from the coastal zone, the author next enters southern Minas Geraes. His route takes him northward to Pirapora on the São Francisco River, with a side trip to Diamantina. Then from Bello Horizonte he travels into western Minas and northward into southern Goyaz. After this he returns southward to São Paulo and thence by the famous "noroeste" railroad through the new coffee lands. This railroad carries him beyond the coffee frontier into the cattle-ranching savanas of Matto Grosso and finally to the Paraguay River, where a boat takes him to Corumbá.

The author describes with the aid of highly generalized sketch maps the essential

features of the land forms of São Paulo state. The crystalline oldland on the eastern border of the state ends abruptly where the covering of sedimentary strata begins. The first (Permian) of these formations is relatively nonresistant and has been worn down to an inner lowland. Beyond, a tableland (Triassic and Cretaceous) faces the lowland with a conspicuous scarp.

After completing the account of his trip to Corumbá, several chapters all too briefly summarize the observations on central Brazil. In these the technical geographer will find the chief contribution. "The final objective of all geography," says Professor Maull, "is the organization of a larger region into individual landscapes and the description of these." He presents sketch maps, again too generalized for detailed use, of the chief culture zones and finally of the major landscape divisions. These maps, like the earlier ones of the land forms, give an excellent general picture of the essential geographic facts of the area, although in some places they are simplified to the point of being misleading.

It is the reviewer's belief that the author would have presented a clearer impression of the landscapes of central Brazil if the narrative sections had been reduced in favor of the summaries. The lack of anything but very brief bibliographic references is regrettable. But the most serious criticism of the work must be of the scarcity of maps and of the highly generalized nature of the thirty sketch maps included. A volume of this size and scope merits a larger number of more accurate detailed maps. The book is illustrated by 160 excellent photographs gathered together at the end of the volume.

PRESTON E. JAMES

A PHYTOGEOGRAPHICAL CLASSIFICATION FOR BRAZIL

A. J. DE SAMPAIO. **Phytogeographia do Brasil.** Map. *Bol. Museu Nacional*, Vol. 6, Rio de Janeiro, 1930, pp. 271–299.

The title of this paper leads one to expect an exhaustive treatise on a broad subject, an expectation which, it transpires, is not justified.

The first few pages are a recapitulation of the phytogeographic classifications of Martius, Caminhoá, Barbosa Rodrigues, Rikli, and Engler; after which the author neatly sums up his whole burden thus:

"Comparing this system [Engler's] with the scheme of classification of Brazilian flora that I now present, and which indicates my views, it will be quickly seen that the latter is nothing more than a slight modification of that part of the phytogeographic system of Professor Engler that relates to Brazil and consists only of the following:

1. Substituting for Engler's 'Südbrasilianische Provinz,' the expressions 'Extra-Amazonian Province' or 'General Flora.'
2. Exclusion of the Ilha da Trindade from the series of zones.
3. Consideration of a Maritime Zone as 5th Zone.

The next ten pages are taken up with the detailed justifications of these changes, which boiled down amount to this: (1) As the type of flora called "Südbrasilianische" by Engler extends northward to the Guianan and Venezuelan frontiers, his term is obviously inappropriate; (2) "General Flora" is an alternative term for the extra-amazonian flora because its areal extent is greater than that of the "Flora Amazonica"; (3) the Ilha da Trindade lacks sufficient endemic plants to entitle its flora to the rank of zone and is therefore reduced to a subordinate position under the Maritime Zone; and (4) the littoral, insular, and pelagic floras are combined as three sections of a 5th zone (to occupy the place Engler accorded to the Ilha da Trindade) because they cannot be admitted to any of the other four zones of Engler's system.

Then comes a discussion of "The Formations of the Flora Amazonica," in which

that flora is divided into three sections, Alluvial Forests, Forests of Terra Firma, and Included Savanas. A brief conclusion gives the revised classification in tabular form.

Finally, with no apparent bearing on the main theme, seven pages are devoted to a section entitled "Campestral Formations in Amazonia." This is merely a list of such localities, with a subsection in which are listed the grasses of the Campos Geraes do Cuminá. A small phytogeographic map of Brazil and a bibliography of 27 titles close the paper.

ERNEST G. HOLT

ANDEAN ARCHEOLOGY

PHILIP AINSWORTH MEANS. **Ancient Civilizations of the Andes.** xviii and 586 pp.; maps, diagr., ills.; bibliogr., index. Charles Scribner's Sons, New York and London, 1931. $7.50. 9½ x 7 inches.

It is a little hard to tell whether this book is meant for the general reader or for the serious student. It would seem as though one purpose was to promote interest in travel in Peru rather than to offer an exact appraisal of the archeological discoveries that have been already made there. The bibliography is carefully compiled, and the illustrations are a valuable feature: they are well chosen and portray most of the important features of the pre-Columbian remains of the Andean civilizations.

The book gives the impression of wishing to convey to the reader Mr. Means's personal opinions and ideas in regard to the history of the countries mentioned rather than to attempt any critically dispassionate judgment on them. There are some singular omissions, for instance the failure to make any reference to the Brüning collections of Chimu objects found in or near Chiclayo and Lambayeque, Peru, and to the studies of Brüning on this particular subject. It is interesting to read on page 32 of an archaic culture in Tierra del Fuego. The reviewer would gladly learn more about this, since he failed to discover any evidences of such culture when there. It is hard to find basis of proof for many statements in the chapter on the "The Earliest Cultures in the Andean Area." There is much about the ancient civilization of the Andes that we shall probably never know; but conjectures and inferences—especially those contained on pages 538–539—can never adequately fill this lack of knowledge.

As a matter of fact a great deal of the information in the gathering of which the writer must have spent considerable time does not seem to have been properly digested, and many of the extraneous facts would have been better as footnotes than embodied in the text. This and the generally involved style do not help the clarity of the pictures presented. It is to be hoped that Mr. Means will continue his studies and some day produce a much shorter book characterized by a greater definiteness. Nobody doubts the energy he has displayed or the persistency with which he has endeavored to unravel one of the most fascinating mysteries of the New World.

C. L. CHANDLER

TRAVELS AND POLITICS IN CHINESE TURKESTAN

OWEN LATTIMORE. **High Tartary.** xiv and 370 pp.; maps, ills., index. Little, Brown, and Co., Boston, 1930. $4.00. 9½ x 6 inches.

"High Tartary" forms the sequel to "The Desert Road to Turkestan," which has already been reviewed in these pages (*Geogr. Rev.*, Vol. 19, 1929, pp. 694–696). In the earlier book Lattimore described a journey made in the winter of 1926–1927 from Peking through Mongolia and into Zungaria. The sequel carries the traveler and his wife on through Chinese Turkestan and across the Himalayas to Kashmir.

The author's reflections on the political situation in Sinkiang, or Chinese Turkestan and its outlying regions, are illuminating. This great province is like a remote colony

of China, cut off by a barrier of deserts and mountains far more formidable than the sea. The problems of government are those encountered by all imperialistic nations in their colonies. They have to do with the settlement of pioneers and immigrants from the mother country and with the administration of native folk of different races and languages.

On the far confines of Zungaria the Lattimores came across communities of settlers from old China—both farmers and townsfolk. Some had been there for several generations; other more recent arrivals still maintained their connections with their old homes. From the shady character of the businesses in which many of the townsfolk were engaged and from the general poverty and squalor of the farmers Lattimore is led to doubt the truth of the common saying that pioneers are of a superior type. So far as these communities are concerned, it would seem that the people who stay behind in the well-populated districts are the more stable and better fitted to hold out against competition. In the valley of the Ili, almost on the Siberian border, there is a curious community of settlers from a single village near Tientsin. "They say that there are—or were in the days of prosperity before the civil wars—many snug homes in Yang-liu-ch'ing supported by fathers or sons far away on the Ili." All these little groups are probably but forerunners of a great tidal wave of immigration that will ultimately pour into Chinese Turkestan, a wave that even now is fast spreading over Inner Mongolia and Manchuria.

In Lattimore's opinion the Chinese may well stand comparison with the British as successful colonial administrators. Both "have in common, whenever they are at their best—the pragmatic instinct for doing the best that can be done on the spot with the men and materials to hand." While China proper has been in turmoil since the revolution of 1911, Sinkiang on the whole enjoyed relative peace and prosperity under the autocratic rule of Yang Tsen Hsin. Yang was an administrator of the old order and after the collapse of the Empire governed almost as an independent monarch. One can only look with misgiving upon the outcome of his murder in 1928. "The pressure on Chinese Turkestan from the world at large, and especially from China itself, cannot be withstood indefinitely. When the frontier breaks, and new factions of Chinese invade the province, a period of rivalry and exploitation will begin. The subject peoples will be lucky if they escape miseries which they never knew under the old autocracy, and the upshot of affairs in that remote intermediary land between the Far East and Near East is unpredictable, what with the conflicting interests of many minor peoples and the inevitable pressure, as it were impersonal and foreordained, of the two major races, Russians and Chinese."

Kenya Mountain

E. A. T. Dutton. **Kenya Mountain.** xvi and 219 pp.; maps, ills. Jonathan Cape, London, 1930. 21s. 10½ x 7½ inches.

This is an altogether delightful book. Major Dutton claims neither prowess as a mountaineer nor deep learning in the natural sciences. Withal, his work is that of a sensitive observer and a gifted and humorous writer, and, with superb photographs and a series of appendixes on special topics, it contributes much to our knowledge of one of the mighty but as yet little-studied mountains of Africa.

Like its loftier neighbor, Kilimanjaro (19,546 ft.), which rises 200 miles to the south, Kenya is an immense extinct volcano (*Geogr. Rev.*, Vol. 12, 1922, pp. 494–496). The original cone and crater of Kilimanjaro have been preserved; but in the case of Kenya erosion has progressed much farther, stripping bare the hard internal core of the volcano. This core or "neck" has been deeply eroded and now stands forth as a group of precipitous peaks. So steep is the highest of these, Batian (17,040 ft.), that after the first successful ascent by Mr. (now Sir) Halford Mackinder in 1899, thirty years were to pass by until the summit was again attained, although in that

interval several attempts were made upon it. In January, 1929, the second and third successful ascents were accomplished by Mr. P. Wyn Harris, Mr. E. E. Shipton, and Mr. G. A. Sommerfelt.

The main part of Major Dutton's book is an account of a *safari* from Nairobi to the upper regions of Kenya in 1926 in company with Mr. J. D. Melhuish. From the eastern base at Chogoria, the climbers' route took them first through a zone of dense forest that encircles the lower slopes of the mountain on all sides but the north. A century ago this crescent-shaped woodland tract was far more extensive than now. Fires and native cultivation have pushed back its fringes. On the east and south sides of the mountain the forest is of a wet type and contains many camphor trees. The drier forests to the west and north are largely of cedar. Above the forests eerie bamboo thickets encircle the mountain slopes between altitudes of about 8000 to 9500 feet. Once beyond these the mountaineers emerged upon broad, sweeping downs, or alpine meadows, overshadowed by the rough crags of the main summits and neighboring lesser peaks. In this open area small tarns and moraines testify to the former presence of more extensive glaciers than those that now cling to the rocks above the 14,500-foot contour line. Beside a frozen pool at a height of 15,800 feet the party made its headquarters in a mountain-climbers' hut whence the higher levels were explored and an unsuccessful attempt made on the summit.

Besides telling of his own experiences, Major Dutton gives an account of Mackinder's arduous expedition in 1899, and reprints as an appendix the narrative which appeared in the *London Times* of the successful ascents in 1929. Other appendixes are devoted to citations from Dr. Lewis Krapf's reports on the discovery of Kenya in 1849 and to brief descriptions of the Mwimbi people and of the geology, flora, and forests of the mountain by Mr. H. L. G. Gurney, Professor J. W. Gregory, Lady Muriel Jex-Blake, and Mr. S. H. Wimbush respectively. A reproduction of a British General Staff map of the higher portion of the mountain on a scale of three miles to the inch accompanies the volume.

Modern Antarctic Exploration

Laurence McKinley Gould. **Cold: The Record of an Antarctic Sledge Journey.** ix and 275 pp.; maps, ills., index. Brewer, Warren & Putnam, New York, 1931. $3.50. 8¾ x 6 inches.

This well written account by the geographer and geologist and second in command of Admiral Byrd's expedition is a welcome addition to our knowledge of the Antarctic. To a geographer perhaps the most striking feature of the expedition was that only a dozen of the 42 members ever saw any Antarctic *land* and that only for some three weeks was it possible to make geological surveys of unknown Antarctica. Yet to balance this lack of rock outcrops, due to the unfavorable position of headquarters, many remarkable facts were gathered about the structure, origin, and shape of the Ross Shelf Ice. Gould narrates only his personal experiences and therefore does not comment on the wealth of geographic data gathered in Byrd's exploring flights.

The book consists of eleven chapters, of which the first describes the hazardous experiences at the Rockefeller Mountains. The next three are concerned with life at headquarters in the long winter. Chapters 5–10 deal with Gould's admirable journey to the Queen Maud Mountains, while the last chapter, entitled "Why," explains the reasons that lead a few adventurous spirits to the Antarctic.

The Rockefeller Mountains consist of a crescentic group of low-lying peaks projecting a thousand feet above the ice. The fearful winds experienced here were utterly unlike those at Little America and seem to be due to nearness of the great plateau of Marie Byrd Land to the east. We learn from the loss of the airplane here that science has yet to devise some adequate means of temporarily mooring an airplane at distances from the main Antarctic base.

It is especially interesting to the reviewer to learn of Gould's natural regret that no airplane was available for his geological expedition, so that he could only use dogs. In 1911–1912 there were no dogs available for Scott's geologists, and four men had to drag 1100 pounds by man power alone. The excellent use made by these young Americans of a method of transport new to them shows that Scott made one of his few errors in distrusting dog power for his journeys. Moreover, Gould believes that the necessary practice of "dog eat dog" saved him 3000 pounds weight on his sledges. The book discusses clearly many details of clothing and equipment which will be of use for many a decade yet. The "snowmobile" was no more successful than Scott's ill-fated motor sledges. The technique of radio on a dog sledge party is particularly novel and is sure to be generally employed in future.

Early in December, 1929, Gould's party reached the Queen Maud Mountains, having had to cross a field of terrible crevasses just at their foot in the Ross Shelf Ice. These crevasses seemed to be due to pressure from the east, as if there were an immense inflow from the plateau in that direction. After investigating coal seams in the Beacon Sandstone high on the flanks of Mt. Fridtjof Nansen (a fine feat in view of the steep crevassed slopes), they turned eastward and discovered three giant glaciers, second only to the Beardmore in size. The great scarp became lower and lower as they sledged to the east, and many of the mountains were nunakols, i.e. rounded by past ice action. The great Leverett Glacier flows almost due west and must be a major factor in supplying the ice of the Ross Shelf Ice.

The party crossed the 150th meridian and so set foot on American soil in Marie Byrd Land. Gould inclines to the belief that there is a land connection between the great new plateau (now called Edsel Ford Mountains) and the Polar plateau, partly because the ice flow comes from the east. The reviewer agrees that the Ross Sea may be a huge graben between Edsel Ford "Plateau" and the Queen Maud Horst; but, though the Carmen Land of Amundsen is now certain to be deleted from the map, we have not much indication yet of a graben wall still farther to the southeast. Gould agrees in general with David's ideas of the ribbed structure of the great Ross Shelf Ice, though he prefers the analogy of a "duck's webbed foot" to David's "primitive wicker shield."

The last chapter is a valuable summary of the scientific problems—in meteorology, magnetism, and geology—that can be solved only by a sojourn in the Antarctic. A little more description of the radio technique and airplane mapping would have been welcome; but these matters were not in Gould's sphere of work. One or two names of explorers (such as Murray and Ferrar) are spelled incorrectly, but the book is a fine piece of work illumined by touches of humor. The reviewer, however, wishes that Gould had included throughout more of his valuable speculations upon polar problems; for he feels that the general public nowadays would welcome such in a book dealing with a scientific expedition.

GRIFFITH TAYLOR

ECONOMIC GEOGRAPHY OF EUROPE

W. O. BLANCHARD AND S. S. VISHER. **Economic Geography of Europe.** ix and 507 pp.; maps, diagrs., ills. McGraw-Hill Book Co., New York and London, 1931. $3.50. 9¼ x 6 inches.

In these our days of international economic disturbances and agreements it is driven home to the scientific worker and to the average intelligent citizen alike that, after all, there does not seem to be left such a thing as a national economy. Politically speaking, we may be citizens of this country or that; but from an economic point of view we are becoming more and more citizens of the world. This trend of affairs will undoubtedly enhance the rôle that geography and more especially economic geography will play in our schools and colleges. Here "Economic Geography of Europe" will serve a useful purpose in the American college.

The first third of the book is given to a discussion of Europe as a whole, the remainder treats the individual countries or groups of countries. In their grouping of countries the authors have not always been fortunate. Finland and the Baltic States, for example, have been grouped together without any definite reasons being given for this rather unusual choice.

The chapter on Hungary bears the title "The Hungarian Plain," but the authors have failed to make clear that Hungary and the Hungarian Plain are two words that are not entirely synonymous. It is also a disadvantage that Hungary and Rumania are separated from other southeastern European countries with similar interests by the chapters on Russia and the Iberian Peninsula and Italy.

In the section on southern Europe are included the coastal lands of the Mediterranean in Asia and Africa. However, no arguments are given why the authors consider such an arrangement desirable or necessary. There is much to be said for including these territories, even though they do not belong to Europe proper; but still more cogent is the argument for an inclusion of western Siberia, which is not treated. In the general part of the book these neighboring coastal lands are not mentioned; neither are they represented in their entirety on any of the maps in this section.

The introductory chapter draws attention to the economic and political importance of the continent and the various factors that may be held responsible for this importance. The two following chapters are given to climates and surface features. A number of statements open to serious objection occur in these latter chapters. The division of southern Europe into physiographic subregions adopted by the authors is unusual and hardly in accordance with the physiographic facts. Statements, of a physiographic nature, that need rectification are found in the general part as well as in the treatment of the individual countries. For example the Danube River does not cut through the Alpine system at Passau but through part of the southwestern edge of the Bohemian massif. Of the Swabian Jura it is said that the sedimentaries dip toward the north. This is evidently a typographic error. What is not true, however, is that the resistant layers end there, where the gradual slope of the Jura ends.

The chapters of the general part on natural resources, distribution of population, and human activities contain some interesting discussions of various European problems. In some instances, however, the conclusions at which the authors arrive are a little too optimistic. It would undoubtedly be a boon to humanity if the number of languages in the world in general, and in Europe in particular, were smaller; but there is little prospect that, within the not too distant future, the peoples of Europe will speak only six or eight languages. The disappearance of the numerous patois and dialects will only result in a firmer intrenchment of the recognized languages, major as well as minor.

In the chapter on the commerce of Europe as well as in the chapters on the individual countries relatively little is said about trade relations between the various countries. Somewhat more attention should have been given to this subject, especially since for some countries the trade relations with their neighbors are of much greater importance than those with other continents. In this part, too, corrections are necessary in various places. For example, sugar beets are not grown especially on the sandier soils of Germany and Poland, Antwerp is not connected with the sea by a canal along the Scheldt, neither does there exist as yet any canal between the Oder River and the Morava River.

The book is well supplied with maps and graphs which greatly add to its usefulness, especially since the graphs are supplemented by a statistical appendix. Some of the maps and graphs, however, are not dated, while other graphs would have presented a truer picture if they had been based on a longer period than a year.

The sources that have been used in the preparation of the book are evidently for

the largest part such as are written in the English language. It is greatly to be regretted that in the bibliographies for the individual countries the titles of some of the best geographic and economic-geographic publications by Europeans are lacking. Where titles of books in other languages are mentioned, these books do not always seem to have been used to full extent. This seems to hold true, for example, for A. Demangeon's "Belgique, Pays Bas, Luxembourg" and K. Zeeman's book on the economic geography of the Netherlands. "The British Empire, a Study in Colonial Geography," by A. Demangeon, is not a translation of "Les Îles Britanniques," by the same author.

In the use of source material we find the weakest point of the book. An entirely satisfactory economic geography of Europe will probably never be written, because of the language barrier to the full study of original sources—a problem that makes the task immensely more difficult than is the case with North America or South America. Undoubtedly this also accounts for the scarcity of publications in the English language on the economic geography of one of the most important parts of the world. All the more this makes the present publication, in spite of its defects, a valuable addition to our textbook literature.

WILLIAM VAN ROYEN

THREE RECENT ITALIAN ATLASES

ROBERTO ALMAGIÀ, comp. **Monumenta Italiae cartographica: riproduzioni di carte generali e regionali d'Italia dal secolo XIV al XVII.** vi and 88 pp.; 65 plates. Istituto Geografico Militare, Florence, 1929. 21 x 15 inches.

Atlante statistico italiano; Parte I: natalità, mortalità, densità della popolazione. 85 plates of maps. Istituto Centrale di Statistica del Regno d'Italia, Rome, 1929. L. 500. 21 x 26 inches.

Atlante internazionale del Touring Club Italiano. 3rd edit., 169 pp. of maps; 224 pp. of index. Edited and published under the direction of L. V. Bertarelli, O. Marinelli, and P. Corbellini, by the Touring Club of Italy, Milan, 1929. L. 400 (L. 300 to members). 20 x 15 inches.

These three atlases are totally different in subject matter. They are alike, however, in that they illustrate the high regard for maps and skill in making them that now prevail and have for centuries prevailed in Italy.

The "Monumenta Italiae Cartographica" is a collection of reproductions in half-tone and line cut of maps of Italy dating from what has been called the *pre-geodetic* period, i. e. the period before triangulation and the astronomical determination of positions became widely employed in surveying. The first great landmark in Italian cartography of this age was the work of Giacomo Gastaldi. The maps in the Greek and Latin codices and early printed editions of Ptolemy's "Geography" had shown the peninsula as running almost due east and west. A more accurate delineation appeared on the famous portolan coast charts, but Ptolemy's major error and many of his minor mistakes persisted until well into the sixteenth century. Gastaldi's achievement was to correct Ptolemy on the basis of the marine charts and the many regional maps that had appeared during the preceding century and to reveal to us Italy in its familiar outlines and orientation. The fifty years following Gastaldi's map of 1561 were notable for the beginnings of *official* cartography. Surveys were carried out under the orders of the territorial rulers for military and fiscal purposes and in response to the need for more adequate knowledge of contested boundaries, water supplies, lines of communication, etc. To these surveys may be traced the direct, if remote, origins of the great survey of a united Italy now being conducted by the Istituto Geografico Militare (see Attilio Mori: La cartografia ufficiale in Italia e l'Istituto Geografico Militare, Rome, 1922). Although the results were for the most part kept secret at the time, the majority of the earliest official

surveys became accessible to G. A. Magini, who used them in the compilation of a superb series of maps known as the "Italia," published by his son in 1622 (see *Geogr. Rev.*, Vol. 10, 1920, p. 418; Vol. 14, 1924, p. 146). It is of interest that Magini's maps were the first to show political and administrative boundaries in considerable detail and for this reason constitute almost the sole documentary source of information on this important aspect of the historical geography of Italy.

Gastaldi's map of 1561, Magini's general map of Italy of 1608, together with others, are reproduced in Professor Almagià's collection. A comprehensive text describes the maps, discusses their sources and derivatives, and gives full bibliographical details. The volume forms, indeed, a *corpus* of priceless material for historian, geographer, archeologist, and student of the graphic arts.

The "Atlante Statistico Italiano," of which only the first volume is at hand, bears witness to a keen appreciation on the part of the official statisticians of Italy of the value of the geographical representation of statistical facts. The maps are all on a uniform scale, 1 : 500,000, and cover areas corresponding to those shown on one of the several series of government topographic maps, thus facilitating direct comparison of the demographic information with the physical and cultural features shown on the latter. The maps reveal by communes—the smallest territorial units for which the requisite figures are available—the density of population at the time of the census of 1921 and mean birth and death rates for 1910–1914 and for 1922–1924. The use of colors is ingenious; shades of red are used for communes having higher averages than the mean for the whole country and shades of blue for those with lower averages. It is to be regretted that there is no explanatory text in the atlas itself, and no general maps on a small scale for the whole of Italy. The latter, however, in the form of colored reductions of the 1 : 500,000 maps, will be found in *Annuario Statistico Italiano*, 1930, Ser. 3, Vol. 4, Rome, 1930, as well as accompanying a geographical interpretation of the atlas by Professor Luigi Galvani ("L'Atlante Statistico Italiano—Parte 1," *Atti dello XI Congresso Geografico Italiano*, Vol. 1, Naples, 1930, pp. 257–266).

It is deeply to be regretted that neither Signor L. V. Bertarelli, Director-General of the Touring Club Italiano (1906–1926), who first conceived the idea of the Italian Touring Club's atlas in 1917, nor Professor Olinto Marinelli, who directed the scientific work upon it, could have lived to see the final fruits of their labor. Both Bertarelli and Marinelli died in 1926, a year before the publication of the first edition.

Even if somewhat formidable in bulk (it is larger and heavier than the "Times Survey Atlas"), the atlas will bring delight to map lovers. Not only are the individual maps clear and beautiful, but the work as a whole is well balanced. One rather expects in a general atlas a disproportionate amount of space to be devoted to the mother country, but this atlas is truly international: Italy receives no special favor. The selection of scales for the "fundamental" maps (i.e. those of the largest scale for each country) is determined on the basis of the density of population and general importance of the areas as a whole. Italy, together with most of western and central Europe and the United States from Maine to Virginia, is shown on the scale of 1:1,500,000; eastern Europe, the whole United States, European Russia, Japan, parts of Brazil and the Argentine, and southeastern Australia on 1:3,000,000; and the rest of the world on smaller scales.

Besides the fundamental locational maps, which remind us of the plates in the atlases of Stieler and Andree, there are certain special maps on a smaller scale. For each hemisphere, for each continent, and for Oceania there is one physical and one political map, and there is also a physical map of the Alps. The physical maps show elevations and depths by contour lines and by colors: blues for depths of water; and greens, buffs, and reds for altitudes. Although these tints are harmoniously and pleasingly chosen, they refer to different levels on different maps, thus rendering

comparisons difficult. Three maps show principal steamship and railroad routes, and two are devoted to the distribution of peoples in Europe (primarily on the basis of language). There are also two maps of the polar regions and 130 insets of cities and areas of special interest. On the back of each sheet a list is given of the sources from which the map was compiled.

One may hardly expect a work of this scope to be without a few defects. We note, for example, that the hachuring in some places tends to exaggerate the relief of plains and low mountains in comparison with that of higher mountains. On the 1:3,000,000 maps of the United States the Sierra Nevada stands out less boldly then the Ozarks or Appalachians. No attempt has been made to mark the conflicting territorial claims of different nations in South America. The boundaries as they are shown would hardly be acceptable to Venezuela, Ecuador, Peru, Bolivia, or Paraguay. Finally, a close examination of a region with which the reviewer is familiar reveals certain minor errors in fact or judgment. Fitchburg and Provincetown, Mass., are represented as county seats; Rumford, Me., as "Bumford"; Castine, Me., is omitted, although the smaller adjoining town of Penobscot is shown; the low summits of Doublehead and Bear Mountain are named in the White Mountains, but loftier and better known neighboring peaks are not indicated.

Defects of the latter type are not serious and may readily be eliminated in later editions. It is apparently the purpose of the Touring Club constantly to revise the atlas. A descriptive pamphlet which accompanies the third edition points out that no less than 4800 changes were made for this edition alone.

Physical Geography of Switzerland

J. Früh. **Geographie der Schweiz.** In 4 parts: 612 pp.; maps, diagrs., ills. Herausgegeben mit Unterstützung der Schweizer Eidgenossenschaft durch den Verband der Schweizer. Geographischen Gesellschaften. Fehr'sche Buchhandlung, St. Gall, 1929–1930. 10½ x 7 inches.

Dr. Früh has presented this volume, the first of a series of three, with the Napoleonic conviction that "la politique des états est dans leur géographie." He offers in Volume 1 a discussion of the physical aspects of Switzerland. Volume 2 will be devoted to the social, economic, and political phases of the country, presumably as affected by geographic conditions, and Volume 3 will present a detailed consideration of selected areas.

Volume 1 is divided into four parts as follows: The Relief of the Land, The Climate, The Waters, The Plant Life. In the last section there is included brief comment upon wild animal life, fisheries, and a short statement relative to the native pride in and preservation of the landscape. While the work as a whole is scholarly and deserving of high praise, it provokes the question as to the extent to which geology or, in general, the origin of land forms, may be incorporated in a geographic treatise. The reviewers cannot help but feel that the author has gone too far in his geological presentation in Chapter 1. They do not believe the function of the geographer to be that of accounting for orogenesis.

Früh's presentation of climate is subject to somewhat similar criticism because he engages in discussion here and there of the physics of the atmosphere. However, he does not go so far afield as in Chapter 1. Furthermore, correlation with the human response greatly enlivens the interpretation. No attempt is made to cover the ground of the statistical discussion found in the elaborate prize essay of Maurer, Billwiller, and Hess (Das Klima der Schweiz, 1909). Rather the discussion is an investigation of special conditions such as relief, exposures, and barriers against westerly influences.

In the controversial matter of inversions of temperature the contribution is important. Früh represents the school that sees the anticyclone as a dominant factor,

and excellent data are presented to support the view. Outflowing air from a baric maximum compressed against the cold air caught in valley bottoms creates pulsating dynamic heat some distance above the valley bottoms. This is the inversion. In the discussion of the föhn and other local wind phenomena new data are cited. An interesting fact in the discussion of winds is that of a true monsoon existing over Lake Constance.

Precipitation is treated in minute detail almost to the point of exhausting the reader. Details of various snow formations are unusual. The section on climate is concluded with a summary of medical climatology of high altitudes. It is but suggestive of the work being done in this field in Switzerland, the details of which are still largely foreign to American geographers.

The presentation represents to a large extent a compilation and accordingly is accompanied by full bibliographical references. Much supporting evidence is supplied in association with explanatory statements. The work being highly inclusive, necessarily many subjects are treated only briefly. On the other hand, for one who desires a convenient review of the physical aspects of Switzerland, Früh has supplied the data in convenient and effective form. As a detailed summary of a very complex region, the work stands as a valuable contribution.

Here and there the descriptions are particularly delightful. The enthusiasm that so many European geographers and geologists acquire for the Alpine area is strikingly revealed in the author's literary pictures of climatic phenomena. Perhaps in the enthusiastic portrayal of his reactions one may see the effect of temperature inversions and their consequent physiological not to say spiritual effect upon the wanderer through the majestic heights of the Alpine massif.

If the same care is shown in the preparation of Volumes 2 and 3 as marks Volume 1, Dr. Früh will have succeeded in presenting not only to his countrymen but to all geographers a monumental work that may become a standard reference upon Switzerland.

RODERICK PEATTIE AND EUGENE VAN CLEEF

THE MISSISSIPPI AND ITS FLOOD PROBLEM

MAURICE PARDÉ. **Le régime du Mississippi.** Maps, diagrs., bibliogr. *Rev. de Géogr. Alpine*, Vol. 18, 1930, pp. 583–693.

An excellent survey and summary of the Mississippi River flood problem is here presented. While nothing new is claimed by the author, he should have credit for assembling the pertinent facts and concentrating them in table and text in such a way as to yield to the reader an understandable brief of the problem. Written largely for his European colleagues, the paper can well be used everywhere as an introduction to the Mississippi River problem. It presents in a concise and vivid way the factors of the hydrology of the river, relief of the basin, nature of the soil, the vegetation cover, the climate, particularly the precipitation, and the immensity of the basin; a second part considers the amount of water and the various stages of flow; and a third part is devoted to floods, their genesis, power, dangers, and remedies.

ROBERT M. BROWN